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Forthcoming Events.

NOVEMBER 7.
British Foundrymen's Association (*Scottish Branch*).—"Moulding and Casting of Ingot Moulds," by John Logan.

NOVEMBER 14.
British Foundrymen's Association (*Halifax and District Branch*).—"Moulding a Flywheel from Strickle Boards and Core Boxes," by J. G. Robinson.

NOVEMBER 20.
British Foundrymen's Association (*London Branch*).—"Foundry Troubles: Synthesised and Analysed," by T. W. Aitken (Luton).

NOVEMBER 28.
British Foundrymen's Association (*Birmingham Branch*).—"Some Applications of Semi-Steel," by J. J. Howell (Birmingham).
British Foundrymen's Association (*Newcastle-on-Tyne Branch*).—Paper by J. G. Robinson (Halifax).

NOTES AND COMMENTS.

To Lag or Lead?

More than one trade is at the present time finding the weak spots in its armour—or rather its constitution; and if the present conflict is prolonged for many more months there will be serious heart-searchings in the case of some manufacturers who have depended on foreign initiative and progressive methods for the supply of semi-raw materials or parts of finished manufactures. At a somewhat late date we are beginning to realise that, though we may lead in certain industries, we decidedly lag in many matters essential to the progress of a nation's prosperity. This is well exemplified in what we might term the commercial application of metallurgical research. Without in any way discounting the useful work of our very few research laboratories—mostly departments of Universities or connected with the armament firms—we have not as an industry given serious consideration to research work as an industrial factor and a valuable weapon in international (or even domestic) competition. In this connection let us examine the motor-car industry; for while the pleasure car has not at the moment much interest for the trade, it is practically impossible to purchase commercial vehicles to-day, as the output of all the factories has been booked for months ahead either by our own or by foreign Governments. This means enormous activity in this branch of industry, with a consequent demand upon the more highly specialised sections of the steel industry. It is calculated that at least half of the material which goes to make the chassis is supplied wholly or partly finished by firms who make a speciality of such components as pressed steel frames, wheels, springs, bevel and worm gears, axles, etc. In addition, however, there are steel, iron and malleable castings, etc. A considerable portion of these orders has been filled in this country, but in special branches, such as thin steel castings, heat-treated drop forgings, and special wearing steels, there can be no doubt that foreign manufacturers have obtained a remarkable hold. The Krupp firm has supplied steel of this character running into hundreds of thousands of pounds in value, while it has been found practically impossible to obtain in this country satisfactory thin steel wheel castings. In cast-steel commercial vehicle wheels the business runs into many thousands of pounds per annum from one or two firms alone. There is no reason why this material should not be equally well produced in this country, but there has unquestionably been too great a tendency on the part of steel-casting firms here to look askance at castings not involving big tonnages. Although competing keenly for castings of good weight, British firms have given far from due attention to the smaller run of work, and have simply let it slide into the hands of the foreigner. It has been forgotten sometimes that orders for small castings, starting in small quantities, may easily grow into large orders, as in the example quoted above of the cast-steel commercial vehicle wheel. There is no reason why the Austrian steel founder should be able to turn out a better wheel at a lower price, and it has been done only by combining technical and practical experience in cases where a study of the market

conditions has shown that the eventual profit was likely to be worth the expenditure.

A warning on this subject was sounded some years ago by Sir Robert Hadfield on returning from a visit to the Krupp Works in Germany. At those works he found huge buildings with a most comprehensive equipment, staffed with an army of chemists whose only function consisted in the technical examination of metallurgical problems before they were submitted to the test of practical experience. What similar organisation have we to set against that? Even if it were an isolated case, which it is not in Germany, where the research laboratory is a recognised and important factor in works operation, the example of Krupps should give us cause for thought. That firm alone has in the past sent to this country huge quantities of special products, simply by reason of accurate investigation and metallurgical research having provided a material to meet specifications which could not otherwise be fulfilled. Many firms in this country have burned their fingers in endeavouring to fulfil, at foreign competitive prices, the specifications of British engineers involving complicated heat treatment. In many cases they have been unable to meet the specification at all. This must be obviously due, not to a lack of experience in, say, steel castings as a whole, because there can be no doubt that British quality in general is better than that of our Continental competitors; but it has been due to a failure to acquire that intimate knowledge of the conditions and factors involved in the production of special articles which can only result from systematic contact with the scientific side of metallurgical work. It is not a question of the remote academic work of a few scientists; it is a matter of organised research work in actual contact with manufacturing conditions and operations, with a view to meeting each new demand as it arises, or even anticipating it. Few private firms have cared to spend the money necessary for this, while also there is a distinct scarcity of trained men suitable for such work. The British view is that each order should show a profit. The foreigner is willing to sink profit for a time so as to acquire the knowledge necessary to meet the particular specification, in the hope that future business will show a handsome return. At the same time it can be done without a huge expenditure, as is shown by the experience of our good friends, the Belgians. It is not too much to say that ten years ago there was hardly a good steel casting made throughout the length and breadth of Belgium, while to-day the quality of Belgian castings ranks with that to be obtained anywhere.

The question we as a nation are called upon to face is whether we are to lead or lag in the competition of metallurgical progress. It is more than a question of national pride in scientific achievements; it is a question of the ultimate integrity and stability of, not only our metallurgical and engineering industries, but also the vast number of other industries that depend upon them.

The Neglected Sand Heap.

The lack of business acumen on the part of some of our steel-trade managers is nowhere more strikingly displayed than in their attitude to the question of suitable moulding sands for steel castings. It has been openly stated by many authorities that nearly every foreman moulder in the steel trade has his own special "compo." which alone will give satisfactory results, though he keeps the secret of its composition very dark. As a matter of fact, it is a commonplace to those "in the know" that steel founders generally (Sheffield included) are always more or less in trouble with their sands. Yet we do not know of one firm which has systematically set out to deal with the problem on scientific lines. The saving in loss from spoiled castings during a couple of months in some Sheffield shops would amply repay all the cost of the research work necessary to place the sand supply perpetually on a sound basis. But it would be first necessary to throw over entirely the claims and prejudices of foreman and manager alike, only admitting them after careful investigation had established their validity. Moreover, the work would have to be done by men whose capability and intelligence allowed them to discard the shackles of precedent and attack the question in the light of reason, and apply their knowledge of chemical and physical facts in a logical manner. There has been much of a vague nature written on the sand question, but too often a knowledge of chemical intricacies has obscured the fundamental considerations involved in founding. Sand research for steel or iron founding is essentially a physical investigation aided and guided by a knowledge of chemical laws and geological facts. Chemistry, of course, comes largely into play, particularly in elucidating phenomena; but even a purely physical investigation is highly valuable in ascertaining the quality and suitability of a sand. Nevertheless, the usual physical test of pouring a large and costly casting into a mould of doubtful sand does not commend itself to us; there are less expensive methods of investigation available.

We are convinced that a large proportion of the moulding material used in the steel trade would, if properly examined and tested by a competent investigator, be quite rightly characterised as "muck." This is not an exaggeration, as a simple fusion test of the material would often show. An extraordinary feature of the case, too, is that often the worse the material the more expensive it is to procure and prepare. Further, a quantity of really good material is frequently hopelessly spoiled by incorporating with it other material of a totally undesirable nature. This results simply from gross ignorance of the real nature of the materials being handled; and though these facts have been facing the trade for years, they have had practically no attention. What the steel trade in particular (and the iron trade to a lesser extent) requires and will be compelled to introduce in the near future, is the systematic examination and control of sand mixtures with regard to their refractory nature, impurities and general moulding qualities. This work is more or less of a specialised nature, but it will not be at all difficult to train intelligent men for it, once the essentials involved are better understood.

ENEMY PATENTS.—It is officially announced that "all persons resident, carrying on business or being in Our Dominions" may pay any fees necessary for obtaining the grant, or for obtaining the renewal of patents, or for obtaining the registration of designs or Trade Marks, or the renewal of such registration *in an enemy country*; and also may pay into the British Patent Office in London on behalf of an "enemy" any fees payable on application for, or renewal of, the grant of a British patent, or on application for the Registration of British Designs or Trade Marks, or the renewal of such registration. The German, Austrian and Hungarian Patent Offices have issued various temporary rules and indulgences to safeguard certain rights of applicants and patentees which might otherwise have been jeopardised or lost by reason of delays arising out of the hostilities. Switzerland, though not a belligerent, has likewise provided for special extensions of time for payments and for other matters.

Lay-Out of a Malleable Cast-Iron Foundry.

A recent issue of the "Iron Age" gives some interesting particulars of the new Belmont Works of the Link-Belt Company at Indianapolis, U.S.A.—a malleable cast-iron foundry with an annual capacity of 7,000 tons, for the exclusive production of chain. This foundry is laid out to reduce to a minimum the average distance through which all materials must be handled and to simplify the handling of materials to the greatest possible extent. The ground plan lay-out devised to accomplish these ends constitutes the principal features of novelty. It may also be pointed out that the character of the product lends itself very readily to the general foundry plan.

trimming room as a centre. It is apparent that these arcs include six out of eight furnaces and only two are at a greater distance. In other words, the average distance through which all cores have to be handled to the foundry and the average distance through which all castings must be handled to the trimming room is about 300 ft., and for more than one-half of the entire foundry floor space these distances are approximately equal. Swinging similar arcs from each furnace illustrates how the distances in three directions through which the hot metal must be carried for pouring have been brought down to a minimum. The limits of the pouring floors from

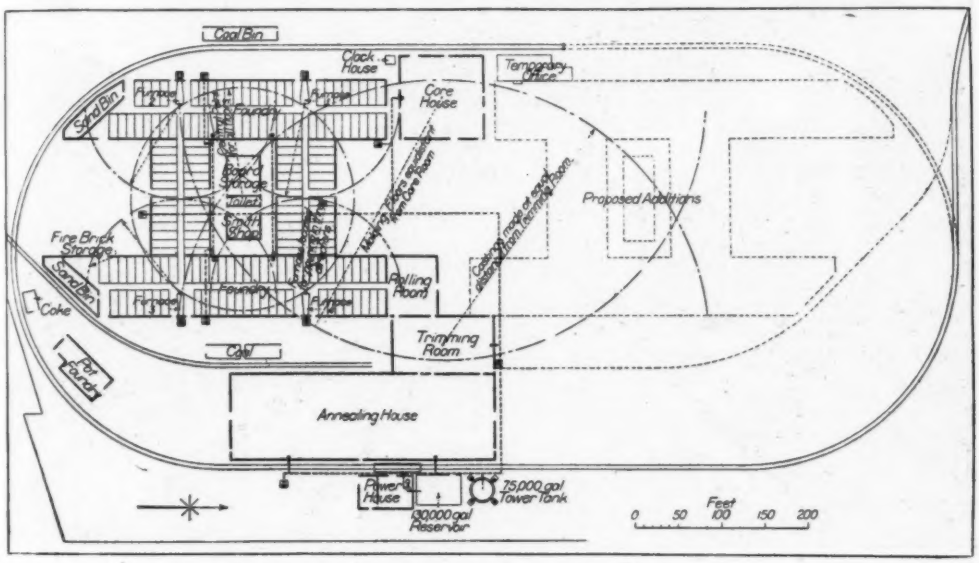


FIG. 1.—GENERAL PLAN OF BELMONT WORKS, SHOWING THE AVERAGE DISTANCE THAT MATERIALS AND METAL ARE CARRIED.

The complete scheme and efficiency of the design are most apparent in a consideration of the plant as it will be ultimately. The buildings shown in full lines in the accompanying general plan constitute the present plant and those in dotted lines the duplicate unit to be built subsequently. Attention is called to the centre line which passes through the core room and the trimming room and constitutes a median line about which the plant activities centre. The plans provide for the ultimate construction of an eight-furnace foundry. The block plan indicates the manner in which these furnaces are located and how the buildings are erected in such a way that it is as though four capital letter T's were placed to form a hollow square, one such group on each side of the median line. At the point of intersection in each T-shaped component of the building an air furnace is located.

To illustrate to what extent this arrangement reduces the distance to be traversed in handling materials and hot metal for pouring, arcs have been swung with the core room as a centre and with the each furnace are at a maximum distance of approximately 70 ft. in a foundry that will have an aggregate floor space of nearly 150,000 sq. ft. The court areaway formed by the layout of the buildings also provides a central location for auxiliary service buildings, such as a storage building for bottom boards from which all of the moulding floors are thus equally distant. This building also houses a blacksmiths' shop, general toilet facilities and the cinder mill.

The general plan also invites attention to the advantages the plant and furnace arrangement offer in the handling of raw materials. The plant site lies between the tracks of the Vandalia lines at one end and the Big Four at the other. Spurs from both railways circumscribe the buildings and on the east and west sides duplicate coal bins and pig-iron storage spaces are located for direct unloading and also in immediate proximity to the furnaces. A wide concrete walk has been laid around the entire plant and particular care is observed in keeping this clean and unobstructed for traffic.

It will be noted from the general plan of the works that the pig-iron which is unloaded from the trucks on gravity conveyors is piled inside of the track, illustrating one of the minor details in which care has been given to the reduction of distance. Sand bins at the south end of both east and west wings are located with equal convenience for unloading direct from the trucks. This applies also to the core sand, the bins for which are in the basement of the core house. Opposite the entrances to the foundry at each air furnace, weigh houses are placed so that the charges of raw material can be weighed in the direct line of transit from storage to furnace.

Within the foundry a similar attention to the maintenance of unobstructed passageways and a general orderliness is conspicuous. The general interior view in Fig. 2 will emphasise this fact. The east and west wings of the foundry and the connecting sections are 70 ft. wide. These floor spaces are laid out with centre aisles 7 ft. 6 in. wide, from which aisles extend moulding floors 31 ft. deep and 10 ft. wide, fronting on the aisle. The furnaces are located at the intersection of the east and west aisles with the north and south and serve approximately 40 floors each. These aisles are laid with a heavy clay mixture packed down to give a hard yet springy footing and are surfaced with a slight crown which is scraped regularly to keep down the accumulation of dirt. They contribute in an important way to the general scheme of the foundry operation.

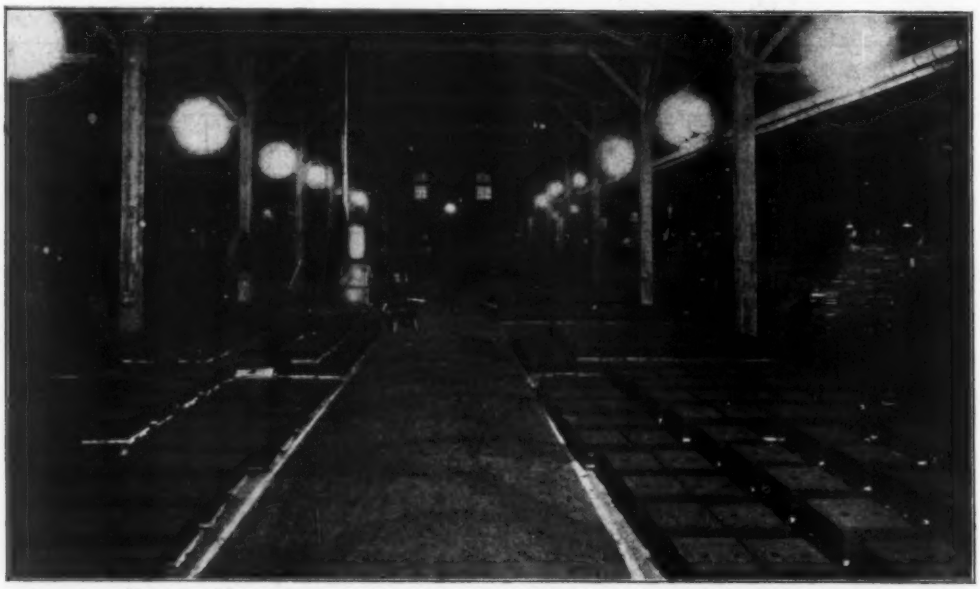


Fig. 2.—Main Aisle in Foundry, with Moulding Floors on Each Side.

Slow-burning, timber-frame mill construction with brick walls and asbestos roofing was adopted for the foundry. With no overhead crane to provide for, the height of the building was required to be sufficient only for light and ventilation. The use of a monitor roof with continuous sash made the width moderate and the cross-section design readily adaptable to timber construction. This construction was used on account of its much lower first cost and because considered more economical to maintain than steel construction in a foundry. It also provides ample strength for the installation of an overhead trolley if that should ever be found desirable.

This construction carried with it the necessity for fire protection, and the entire plant is districted in six stations, corresponding to six hose houses. An automatic sprinkler system also is installed. The fire pump, located in the power house, is of the direct motor-driven centrifugal type with a capacity of 1,000 gallons per minute. It is connected to a 130,000-gallon reservoir storage. There is also a 75,000-gallon gravity tank. Twenty-five thousand gallons from the top of this tank is available as a domestic water supply.

The melting furnaces (shown in Fig. 3) have a capacity of 12 tons. The length of hearth is 18 ft. 6 in. and the width tapers from 6 ft. 6 in. at the front bridge wall to 3 ft. 9 in. at the back. The firedoor for the firebox is at the side of the furnace near the front end and is canopied with a hood and flue so that the smoke from the soft coal at the time of firing is carried off at once and does not contaminate the foundry air. The ashpit clean-out is at the front of the furnace. Fig. 3 shows the manner in which the rear end of the furnace is built through the wall of the building to the self-supporting stack outside. These stacks are of the standard hollow-tile jacketed type.

The air for the furnace is brought underground from a direct-connected motor-driven blower mounted on a concrete pier about 5 ft. above floor-level. This concrete pier is hollow and the air is delivered down through it. It is fitted with an extra opening at one side so that in event of the blowing unit above going out of service, a duplicate spare blower unit mounted on a track may be run up to the pier, the air and electrical connections made in two or three minutes and the service continued almost without interruption until the regular unit is repaired.

The moulding is handled with power and hand machines and operator for each floor. Emphasis is placed on safety in the various foundry operations

and it has been found in connection with taking hot metal from the furnace that the number of men accidentally burned is greatly reduced where the moulder cuts in with his ladle toward the furnace, instead of the reverse method of bringing his ladle in under the stream of metal from behind. The pouring is entirely by means of hand ladles.

The squeezer type of machine is used, the equipment including two makes of hand squeezers and four of power squeezers. Metal patterns are employed exclusively with snap flasks and the equipment is regularly inspected to preserve the necessary accuracy in castings.

In addition to its feature of central location, the core room presents a number of carefully planned details. The core sand is prepared in the basement. It is discharged directly from trucks in the yard above to concrete bins which front on the grinding and mixing floor. Used sand from broken cores is returned from the floor above through a chute directly into a grinder without handling and, mixed with new sand, constitutes a portion of the core-sand mixture. The sand is transferred to the bench floor on an electric elevator. This basement also affords space for a coke-storage bin, between and below the two batteries of core ovens, the coke being

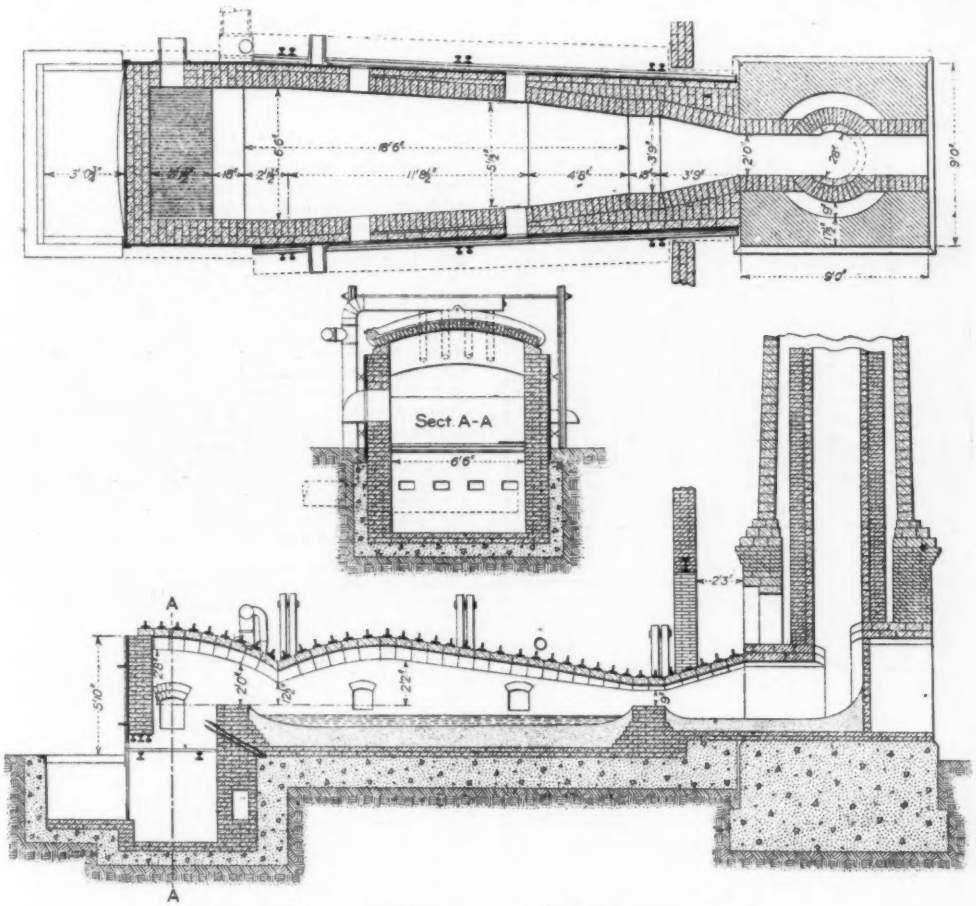


FIG. 3.—PLAN AND ELEVATION OF 12-TON MELTING FURNACE.

Helpers who, in addition to shifting, shake out the moulds, wheel sand and break the links from the gates and risers into a steel barrel in which they are wheeled to the rolling room, are available at whatever floor they may be required. Water is brought to each moulder for wetting down his sand and floor, a hose connection being suspended from a swinging jib overhead, one jib serving three floors. The machines are placed directly under the windows, where excellent light is always available and where fresh air can always be secured by the workman. Vines have been planted to cover the buildings so that the outlook for the men will be made pleasant. A locker is provided at each bench for the men.

wheeled in from the yard on the main floor and dumped into this bin.

The core ovens, the general type of which is illustrated, are fired from the basement floor. The concrete enclosed basement space also provides fireproof storage for patterns, eliminating the necessity of a specially constructed building for that purpose. The patterns are stored on shelves in rows and for the lighting of the passageways between an especially economical arrangement has been adopted. A high-power tungsten light is hung at each end at such an angle that the light is thrown into the aisle from both ends toward the middle. Ample illumination is thus attained with but two lights for each long

passageway. The main floor of the core house is occupied in part also by a machine shop and carpenters' shops for general repairs, and a storeroom for miscellaneous stores.

The rolling and trimming rooms which adjoin are, like the core house, in a central location. The rolling equipment consists of four batteries of barrels. In the trimming room, the sorting and inspection benches flank either side of a central gangway which is reached by means of an inclined approach. The pieces are brought from the rolling room in wheelbarrows and run up on this bench runway and dumped onto the bench compartments on one side, where the different kinds of pieces are sorted and trimmed. For grinding the gates from such pieces as require it, there are installed semi-automatic grinding machines. In addition there is a group of standard double-end machines for hand grinding.

The annealing house, because of its wide span, has a steel framing. A unique feature of the building construction is the use of three kinds of flooring in the space from in front of the furnaces to the opposite wall. Immediately in front of the annealing furnaces there is a vitrified brick floor 20 ft. wide, used as a cooling floor, on which the hot annealing pots are placed when they are drawn from the furnace. Adjoining this and for a width of 30 ft. there is a heavy creosoted wood block floor which is used for dumping and packing pots. Beyond the creosote block floor and extending to the wall for a distance of 20 ft., there is a cement floor which is used for trucking and storing materials until they are packed for annealing.

The general design of the annealing ovens, their size, the double firebox arrangement and the system of heat distribution are apparent from the illustration (Fig. 4). For casting the annealing pots a small isolated foundry is provided, connected with the annealing house by a broad brick roadway so that the power charging machine can be used for transferring the boxes to and fro. The cupola is a 36-in. stack.

The Belmont plant was designed and constructed by W. I. Ballentine, superintendent of the Indianapolis plant.

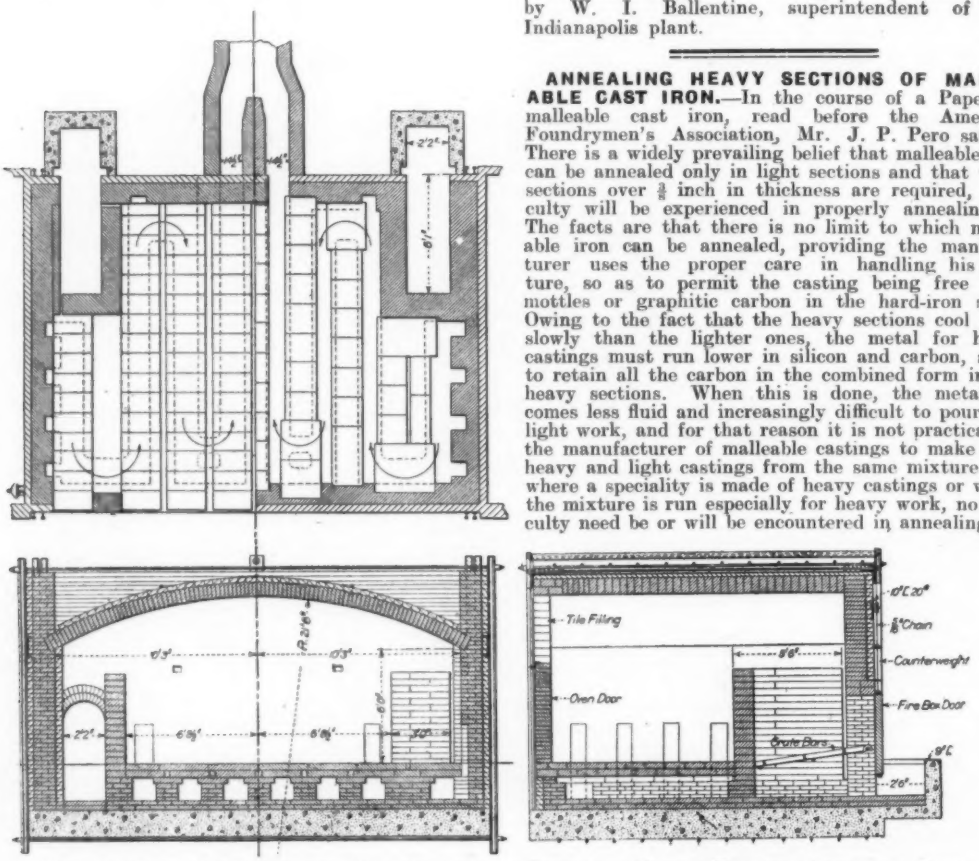


FIG. 4.—PLAN, ELEVATION AND SECTION, SHOWING DESIGN OF DOUBLE FIRE-BOX ANNEALING OVEN.

ANNEALING HEAVY SECTIONS OF MALLEABLE CAST IRON.—In the course of a Paper on malleable cast iron, read before the American Foundrymen's Association, Mr. J. P. Pero said:—There is a widely prevailing belief that malleable iron can be annealed only in light sections and that when sections over $\frac{3}{8}$ inch in thickness are required, difficulty will be experienced in properly annealing it. The facts are that there is no limit to which malleable iron can be annealed, providing the manufacturer uses the proper care in handling his mixture, so as to permit the casting being free from mottles or graphitic carbon in the hard-iron state. Owing to the fact that the heavy sections cool more slowly than the lighter ones, the metal for heavy castings must run lower in silicon and carbon, so as to retain all the carbon in the combined form in the heavy sections. When this is done, the metal becomes less fluid and increasingly difficult to pour into light work, and for that reason it is not practical for the manufacturer of malleable castings to make both heavy and light castings from the same mixture, but where a speciality is made of heavy castings or where the mixture is run especially for heavy work, no difficulty need be or will be encountered in annealing the castings through and through, as all that is necessary to anneal them is to bring the castings up to the proper temperature, in which no difficulty is experienced, as it is manifest that when the annealing pots, which are usually 18 to 24 inches in thickness, are heated through, a heavy casting will be heated through just as readily as a lighter one.

TRADING WITH THE ENEMY.—At a meeting of the Sheffield Chamber of Commerce, last month, a letter was received from the British Engineers' Association, and the Chamber decided to make representations to the Government in favour of proclamations being made much more stringent. In the opinion of the Chamber, there is no doubt that by means of branches and agents and in other ways an illicit trade is being done with the enemy, which ought to be stopped at once.

The Moulder, To-Day and Yesterday.

Address before London Foundrymen.

The opening meeting of the session of the London Branch of the British Foundrymen's Association was held on October 16, when Mr. J. Ellis read a brief presidential address as follows:—

At the opening of a new session of this Association it may not be out of place to offer a few comments on the foundry trade in some of its aspects as compared with a few years ago. In all crafts it is both instructive and interesting to make a retrospective survey, and in the foundry trade it is particularly interesting to do so, for the developments that have taken place of late years on the scientific side have been accompanied by economic changes which tend to considerably influence the purely practical side. A retrospective view is therefore desirable in order that we may note the advances made and also the retreats recorded. Whatever the progress which any trade makes in the course of evolution, there is always some branch or section which tends to lag behind, though only slightly.

I will not trouble you with references to the ups and downs of a moulder's daily life at his calling, for in all ages a craftsman must meet with many of these. Instead I propose to take a cursory glance backwards and compare briefly the product of the moulder's art of some years ago with that turned out of our shops to-day—in other words, to contrast the work of the present-day moulder with his earlier brother.

It would be idle to pretend that there were no "wasters" produced a few years ago; that would indeed be absurd, for I have made some myself, and seen others make them. But generally speaking, castings turned out in former days were very much better than those of to-day, particularly as regards appearance and finish. The workmanship was most exact. All bosses and flanges that possessed sharp corners were given their precise angularity, and all rounded parts were produced smoothly curved. The moulds were finished in a distinctly high-class manner, and when the castings appeared they were really beautiful. One seldom now sees such a perfect skin upon castings, and though in the majority of cases a casting is equally serviceable whether it possesses a rough or a smooth skin, yet from a foundryman's point of view, rough skins on castings are an abomination. A rough skin as a rule speaks plainly of scamped work or insufficient time allowed to finish the mould. These two faults cannot be excused on the ground of defective material, etc.; they can only be due to lack of care and slipshod methods of working on the part of the moulder.

In this particular matter the moulder of to-day is, speaking generally, inferior to the old-time craftsman, and we may well enquire why that should be—whether the British foundryman's ability is deteriorating or whether he is merely worked under greater pressure and not allowed to exercise the proper care and attention in his work. We should undoubtedly be able to produce far better castings to-day than formerly. There can be no question of that. The advent of modern machinery for moulding, sand-mixing and fettling, and the access to better materials such as coal-dust, blacking, plumbago, core-binding material, wax vents, etc., give us very great advantages over the old-time moulders.

The metallurgist and chemist have aided in placing the control of mixtures on a sounder basis; furnace operation is becoming more and more an understandable and exact art; and the principles of design in relation to metallurgical phenomena are far better understood than formerly. Yet with all these splendid innovations do we produce correspondingly better castings? We certainly turn them out at considerable less cost, but in many cases a technically better product is not obtained, largely as the result of what might fairly be termed poorer workmanship on the part of the moulder. The question may then be asked: Would it be possible to improve upon our work if more time were allowed to finish the moulds, or are we incapable of concentrating our energies upon our work to the point of at least equalling our forerunners?

I cannot believe that the inherent capability of the foundryman of to-day is less than formerly—in respect at least to technical skill. If it were, the so-called advances in education and opportunity might well be termed wasted. It appears, rather, that there are factors operating to-day with which our fathers did not have to contend, and these act detrimentally in the development of craftsmanship. The speeding-up of modern industry both distracts from quiet, careful attention to detail and creates a desire for a more absolute relaxation from work outside of work hours. At one time the workman's only consideration was his craft; it was his occupation and hobby combined, for the simple reason that there were extremely few counter interests to distract. To-day the moulder and apprentice alike find a persistent distraction in sports and amusements that were outside the range of the old-time moulder. It is therefore necessary to combat any tendency for these distractions (highly desirable and even admirable in their place) to encroach on the attention which such a trade as founding justly demands.

It is probably inevitable that there should be some tendency, in the desire to get rich quickly, to scamp work and turn out shoddy castings. But one would hardly imagine any moulder worthy of the name spoiling his otherwise good work by a bad finish. Perhaps the moulder hurries over his work under the impression that if he does not use all possible dispatch, he will be superseded by the moulding machine. There is no need for this fear; a good foundryman capable of producing high-class work can never be superseded by a machine.

Whether, however, we can at the moment correctly account for this departmental decline in the foundry art or not, the problem faces us, and it is necessary in the interests of the trade that it be dealt with. Many things may be conducive to deterioration in such a trade, and among these are the working conditions. There is no reason to suppose that because the foundry is a dirty place, the foundryman should be less clean than in other departments, or be given less facilities for keeping himself respectable. A moulder who is clean and particular in himself will not cause any accusation as to slipshod or dirty work. Much has been written, and rightly so, regarding the

education of the foundryman; and the movement to that end has done much good. But it will have to be accompanied by a movement for the education of the chemist, in the practical side of foundry work. Without disparaging the higher branches of foundry education, it is only fair to say that it is equally important for the chemist to attend to his own practical training and knowledge. Surely this should be almost as much a subject for study as the actual chemistry. Experience and thorough knowledge can only be gained by practical experimenting, not by theoretical explanations. Theory, unfortunately, does not always justify itself when practised.

Another query of importance in the foundry world is: Does modern education deplete the market of the most suitable material for moulders? This is a large question, and few realise the capabilities and extensively intricate nature of foundry work. In conclusion, may I say that these brief remarks are intended to direct attention to the importance of keeping perfection in practical work as much to the front as scientific attainments. Founding is dependent first and foremost on the craft-skill of its workers; and the British Foundrymen's Association would ill serve its craft if it did anything to obscure that fact.

Mr. A. Willis, in proposing a vote of thanks to the President for his address, said that the address had been practical and far-reaching, and was very suitable at the opening of a session when a fresh start was being made. It was hoped this session to enlist more the interests of the practical man in the foundry trade; and the President being a practical man, had dealt with the foundry question from a practical standpoint. Without criticising the address, he (the speaker) would like to say that he did think that whatever was lacking in the quality of the work turned out to-day as compared with "historic" times, was due to the economic pressure that now existed. Twenty or thirty years ago the pressure in the brass-foundry trade was not nearly so great as to-day, and he presumed that in the iron-foundry trade the same thing applied. A very much larger amount of work had now to be produced for a given weight of castings. Brass castings had got lighter and lighter. Better metal was used, and often metal that would stand pressure, but of a lighter section. Castings had to be made to-day that looked very nice, but which were practically films of metal, and as the moulder's work was to produce castings as cheaply as possible, he had to produce, perhaps, 50 per cent. more moulds in order to get a given weight of castings. Altogether, he thought the moulder did not get the time that he used to get to finish his moulds.

Mr. A. R. Bartlett, in seconding, remarked that he could, speaking from the foundry side, heartily endorse every word Mr. Willis had said. Mr. Ellis had correctly stated that the foundryman did not produce the same work to-day as formerly, but he (the speaker) did not think it was that he could not make it: the real fact was that the opportunity of making it was lacking.

The vote was carried with applause.

The President then announced that Mr. D. Gordon would give a lecture on "Bronze Statuary." This lecture and the discussion thereon will be dealt with in our next issue.

British manufacturers and merchants, wishing to obtain a market in Sweden, are invited to write to the Secretary, Swedish Chamber of Commerce in London (Incorporated), 5, Lloyd's Avenue, London, E.C., in order to obtain names of importers and advice on commercial conditions in Sweden, etc.

Abrasives.*

By Clarence Hawke.

Abrasion is defined as the wearing away of one body by another of harder material. The body of harder material is then known as an abrasive, and this term may be applied in its true sense when referring to certain grinding and polishing materials. In its specific sense, when used in connection with modern artificial abrasives, the term is incorrectly applied, as these materials cut rather than abrade. The term "abrasive" has, however, been given a wider significance, and now includes generally all materials used in the grinding or polishing of other substances.

Natural Abrasives.

The first materials used by man as abrasives were used in their natural state. With the advance of knowledge in connection with the applied arts, a more rapid method of abrasion was sought. This was found in the grindstone, which consisted of a block of natural sandstone hewn into the form of a disc several inches in thickness and rotated slowly by means of a crank fastened on the shaft. The use of the natural stone wheels was limited very largely by the fact that they did not have the physical properties, strength, etc., required for the effective grinding of metals. Grindstones in their original form, and improved by the power drive, are, however, still in use, and a reason for this may be found in the fact that the machinery required to operate them is of the simplest form.

The next important advance was made when certain natural materials possessing abrasive properties, but found in nature in a form unsuitable for use, were crushed to grain of a desired size, mixed with a bonding material and the mass moulded into the form of a wheel. Such wheels could be operated at a considerably higher peripheral speed than was possible with the grindstone, and could be made of materials possessing higher abrasive qualities.

Emery.

One of the first materials to be used and to become of value for the production of this new and improved form of abrasive tool was emery. Emery is a material many times harder and tougher than the abrasive constituent of sandstones, and is the intimate mechanical admixture of corundum and either hematite or magnetite, both of these latter mentioned minerals being compounds of iron and oxygen. Its value as an abrasive depends upon the amount of corundum present. It is extremely tough, and were it not for the fact that the emery obtainable from nature's store varies considerably in quality, and is often high in impurities, it would be of high value for certain classes of grinding.

As a binding material for these abrasive grains hydraulic cement was first used, in an attempt to imitate the natural stone. This failed conpletely and a further step was made in the adoption of organic or vegetable substances, such as rosin, sulphur, rubber and shellac, and silicate of soda, the three latter materials being successful in a certain field. Such bonds, although still found to be of value in the preparation of grinding wheels for special work, are not adopted for grinding operations where large quantities of material are to be rapidly removed. Bonding materials of an abrasive nature were, therefore, substituted in the place of the vegetable bonds previously used. These bonds consisted principally of fusible clays which were

* Abstract of Paper read before the American Foundrymen's Association, Chicago Convention, September, 1914.

mixed with the abrasive grain, the mass formed into the desired shape and then brought to a temperature sufficiently high to vitrify the mass. The actual amount of abrasion performed by a binding material of this kind in an abrasive tool is believed to be negligible, and in fact has been shown to be productive only of heat. This applies to any binding material, but as a bond is necessary in the preparation of any abrasive wheel composed of an effective abrasive, this factor must always be considered and reduced to a minimum. Such a result can be accomplished best with a vitrified bond. Difficulties were experienced with the bonding of emery grains with this type of bond, as the impurities contained in the emery, together with the uncertainty of its quality, prevented the attainment of duplicate results.

Corundum.

Along with the development of better methods of bonding abrasive grains, other natural materials were substituted for emery, principal amongst them being corundum. Corundum, which is an aluminum oxide, is found in nature as crystals usually rough and rounded, or massive with nearly rectangular partings. There are many varieties of corundum, of which the ruby, sapphire and emerald are of the gem class. Corundum is, as has already been stated, the abrasive constituent of emery, in which it is so finely divided that it cannot be separated from the other components.

Next to the diamond, corundum is the hardest known material occurring in nature. In Mohs' scale of hardness corundum is given as 9 compared with the diamond as 10. The hardness of corundum must not be confused with its abrasive efficiency, for although corundums vary but slightly in hardness, there is often a wide variation in the amount of abrasion which they are able to accomplish. The hardness represents the resistance of the corundum to abrasion, or to being scratched by another material, and also its power to scratch another substance. A fragment of corundum entirely free of decomposition may when tested prove to be of a hardness represented by 9, but to have a cutting efficiency that is very much lower than that of another piece whose hardness is just the same. The abrasive efficiency of a mineral or substance depends upon its hardness and fracture. The fracture should be irregular and not along parting planes as is often the case with corundum; in other words, the cutting efficiency depends upon that property which enables it to retain a sharp edge when crushed into grains. All corundums to not possess this property, and many that exhibit it in the first stages of crushing do not show it in the finer fragments or grains.

As corundum is a product of nature it is often associated with foreign materials which are always softer than the corundum itself. These foreign materials, if present in large quantities, affect the abrasive efficiency very materially. In the earth's make-up certain grades of corundum are obtainable which are suitable for abrasives, and by proper selection it is possible to obtain a grade of corundum of a fairly uniform quality, but as parting planes of fracture exist to a large extent in all corundums, its abrasive efficiency is effectively reduced by this factor. If it were not for this fact corundum would be of exceedingly high value in the grinding of materials possessing toughness.

Garnet.

Garnet, although of no great importance in the grinding of metal, has been found to fill an important place in the grinding or sanding of wood. For this class of work the garnet grain, after being thoroughly cleaned, is affixed to the surface of either cloth or paper, by means of suitable glues, and is in this way used either in the hand or in the form of belts or discs mechanically driven. As garnet has a low point of fusion it is impossible to bond the material in the form of wheels with anything other than vegetable and silicate-of-soda bonds. This fact limits its value considerably. In the scale of hardness, garnet lies between 7 and 8. This particular degree of hardness does not, however, account for its high value in the grinding of wood. The more probable explanation of this peculiar property is found in the fact that a fragment of garnet is seldom solid, but fractured along irregular planes. This property permits the grains to be easily broken down so that sharp cutting edges are always in contact with the fibrous material being ground.

Artificial Abrasives.

There are several reasons for the superiority of an artificially-produced abrasive material, over those obtained from nature's store. Principal among these is the possibility of obtaining a far more uniform and pure product by artificial means than can be found in the earth's make-up. The regular cleavage existing in some natural abrasives can be eliminated in the artificial, and the reduction of the abrasive efficiency from this source overcome. Further, artificial abrasives have been produced possessing far greater hardness and abrasive properties than anything that nature has supplied, with the exception of the diamond. The difficulties caused by the impurity and un-uniformity of the natural abrasives had attracted the attention of many prior to 1891, in which year E. G. Acheson discovered an entirely new substance, silicon carbide, better known under the trade name of carborundum. The discoverer of this new material quickly realised its possibilities in the abrasive field, as it was found to possess a hardness far above that of anything found in nature, with the exception of the diamond.

Silicon Carbide.

Silicon carbide is a material composed of one atom each of silicon and carbon. These two elements are driven together by means of the high heat of the electric furnace and the resultant material is found to possess a hardness of nearly equal that of the diamond, or from 9.6 to 9.7. In addition to its extreme hardness, silicon carbide possesses the characteristic of sharpness. This characteristic is accounted for by the fact that the crystal has an irregular fracture and always breaks down into fragments with sharp cutting edges. The combination of these two properties, hardness and sharpness, make this material an ideal abrasive for the grinding of cast iron, chilled iron, bronze, brass, granite, marble, etc. Silicon carbide is slightly more brittle than the diamond and to this property may also be attributed its extreme sharpness. Made at a temperature of approximately 2,200 degrees Cent., the grain is not affected by fusion with the proper clays, and vitrified wheels are successfully made. The purity of the final product can be controlled within definite limits, so that uniform results can be obtained. Silicon carbide is found on the market under several trade names, principal among these being carborundum and crystolon.

Artificial Aluminous Abrasives.

In the manufacture of this class of abrasives highly aluminous clays are fused in an electric arc furnace in such a way that the impurities contained in the raw material are reduced, and a product consisting of almost pure aluminum oxide in crystalline formation is obtained. This fact, which is common to all artifically produced abrasives, is explained by a consideration of the probable differences in the rate of crystallisation of a body produced artifically and by natural means. In the latter case the crystallisation has obviously been slow, and consequently well developed crystals are formed along

well developed lines. The crystallisation of an artificially produced material is more rapid, with the result that the crystals formed are irregular and possess irregular fractures. Abrasives of the artificial aluminous class are characteristically tough, fracture into sharp, irregular crystals and do not possess the regular cleavage common to the natural aluminous abrasives. The hardness of such materials lies between 9.1 and 9.2, which is above that of the natural corundum. Artificial aluminous abrasives are successfully bonded by the vitrified process, and have been found to give excellent results in the grinding of steel and metals possessing extreme toughness. Abrasives of this class are found on the market under the trade names of aloxide, alundum, abrasite, dilemite and barocarbon.

Scale of Hardness.

A more careful consideration of Mohs' scale of hardness, to which reference has already been made, is necessary at this point for a clearer understanding of the differences existing between abrasives. This scale of hardness was introduced by Mohs, a German mineralogist. Mohs chose ten commonly occurring minerals, each of practically constant hardness. These were arranged in order according to their ability to scratch or abrade one another. For the softer of these materials talc was chosen and given a hardness equal to 1, and placed at the bottom of the scale. The other minerals were then placed in position upon this scale according to their ability to scratch other substances, or to be scratched by them. In this case the diamond was placed at the top and given a hardness equal to 10. Corundum (sapphire variety) was placed next below it and given a hardness of 9. The topaz followed next in line with a hardness of 8. Here it should be noted that owing to the imperfection of this scale, the actual difference existing between a hardness shown as 9 and one shown as 10 is considerably more than between 9 and 8. This is accounted for by the fact that minerals with a hardness greater than 9 are not common, and because of the experimental difficulties in determining the hardness of such substances. It is, however, generally conceded that the difference 9 to 10 is approximately equal to the difference 1 to 9. Carbide of silicon is therefore probably two or three times harder than the next below it, or those of the class of artifical aluminous abrasives. These in turn are considerably harder than the natural corundum, although their position on the scale is only slightly removed. Mohs's scale of hardness does not give an accurate figure for the hardness of a body, but simply shows its hardness relative to another body.

Choice of Abrasives.

When choosing the correct abrasive to perform a particular grinding operation it is necessary to carefully consider the properties of the material to be ground. As has already been stated, the hardness of an abrasive is not always the determining factor, for if this were so the hardness would give the best results under each and every condition.

A vital factor to be considered in connection with any grinding operation is the production of heat. The production of a certain amount of heat is common to every grinding operation. This heat can, if produced in excess, work disadvantageously by either burning or drawing the temper of the material being ground, or by causing the grinding tool to fill with the overheated material which it is removing. The production of heat is dependent upon three factors; first, the ultimate strength of the material being ground; second, the rate of removal of stock; and third, the contact area of the grinding tool with the work.

If an attempt is made to use an abrasive possessing the qualities of extreme hardness and sharpness to grind a material which is tough and of high tensile strength, it is found that excessive heat is generated; in other words, the amount of work performed by such an abrasive upon the metal of high tensile strength has been sufficient to produce excessive heating, with the result that the abrasive tool is ruined by filling, or the work burned.

For the grinding of hard materials which are of a low ultimate strength, or such materials which are not easily fused, the hardest abrasive is successfully used. When, however, materials of high ultimate strength, or materials which are characteristically tough, such as steel or malleable iron, are to be ground, superior results are obtained from a softer abrasive, such as found in the artificial aluminous class, as the penetration under a fixed or constant pressure would depend to a large extent upon the hardness of the abrasive. Upon the extent of this penetration depends the amount of work done and also the amount of heat generated. Although a deep penetration is permissible in the case of a material of low ultimate strength, or one that is not easily fused, it is liable to produce excessive heating in the case of materials of high ultimate strength.

Another characteristic which is essential to an abrasive for the successful grinding of steel is toughness. This property is possessed in a marked degree by abrasives of the artificial aluminous class, and is responsible to a certain extent for their superiority for the grinding of tough metals, over the harder but less tough abrasive silicon carbide. This characteristic is obviously essential to the successful grinding of such materials when we consider the necessity of the abrasive grain holding the bite or depth of penetration taken and carrying it across the contact area of the tool with the work. If an abrasive grain is not sufficiently tough to hold such a cut and withstand the strain put upon it by the resistance of the material being ground, it will fracture too rapidly, or before it has had sufficient time to perform the work required of it. Such a condition would result in an excessive wheel loss without the required removal of material. The slightly softer but tougher artificial aluminous abrasive is favoured in this respect in two ways when called upon to grind materials of high tensile strength; first, as the slightly softer material does not penetrate or bite into the material being ground, to the extent of a harder abrasive, the depth of bite and consequently the strain put on the individual grain is not as great as would be the case with a harder material. Secondly, with superior toughness it is able to hold the cut or bite taken, which in the first place is not as great as would be the case with the less tough but harder and sharp abrasive.

The necessity for selecting the correct type and grade of bond has already been referred to. For such a selection a knowledge of the actual conditions under which a grinding operation is to be performed is essential. The grade or degree of binding required in an abrasive wheel is governed to a large extent by the amount of dressing action present in the operation. The contact area of the wheel with the work, the relative speed between wheel and work, as well as the depth of the cut and the condition of the surface being ground, all tend to control the amount of dressing action produced. These must all be considered in addition to the properties of the material being ground and the final finish required. Other important factors are the application of the abrasive wheel to the work and the construction of the grinding material used. If the work is automatically applied to the wheel, a far more loosely bonded wheel can be used than is required to grind similar materials applied by hand, as the dressing action in the former case is far less than in the latter. For precision work rigidly built machinery is absolutely imperative to the production of satisfactory results. This factor must receive consideration when selecting the

correct abrasive wheel for such work, as vibration increases the dressing action upon the wheel considerably.

In general, the successful bonding of the correctly-chosen abrasive grains into the form of an abrasive wheel or tool depends upon the property of the bond used to break down at the proper rate This rate should be sufficient to allow each abrasive grain to perform the maximum amount of work possible to such a grain before it is released from the mass of the wheel. It should also be sufficient to prevent the wheel from glazing. In other words, the grade or hardness of the abrasive tool should be sufficient to permit a rate of wearing away which will at all times leave a sharp cutting surface on the abrasive tool and allow for a maximum utilisation of the cutting possibilities of each grain of abrasive material. The size of the grit also largely affects the rate of removal of material, and consequently the heat developed. The final finish, too, depends upon this factor.

It is a general practice among abrasive-wheel manufacturers to signify the size of the abrasive grain used by adopting numerals representing the number of the screen through which the grit designated has passed. These screens are numbered in accordance with the number of meshes per linear inch, so that a grit or grain designated as No. 24 would imply that the grit had passed through a No. 24 mesh screen, but would not pass through the next finer mesh used in the system.

Grinding Castings.

With information to the effect that a certain wheel to run at a normal speed of 5,000 surface feet is required to grind cast iron, it is not always possible for a wheel manufacturer to supply the right wheel. The actual grade of the cast iron used should be specified in such a case. Stove castings, for instance, are made of a mixture to produce a fine-grained even iron; machinery castings are often made of a similar grade. In a so-called job foundry the grade of metal will show greater variation and as a rule run coarser and harder. Other conditions being equal, it is found possible to use a harder wheel to grind fine, soft iron than is required for the harder, coarser metal, with equally rapid results.

As a general rule it is found that wheels composed of carborundum of grits represented by from 16 to 24 and bonded with a high or hard bond, will give excellent results for the grinding of cast iron. The coarser grit wheel is generally used on the heavier castings where large amounts of material are to be removed; the finer grit wheels for the smaller and lighter castings.

When malleable-iron castings are to be ground the details of each operation should be more carefully considered than in the case of cast iron, as actual experiments have shown that the quality and texture of malleable irons met with in different foundries vary considerably. As in the case of cast iron, coarser wheels are used on the heavier castings and finer wheels on the smaller. With this material, as with steel, abrasives of the artificial aluminous class have been shown to give superior results to carbide of silicon, for reasons already stated. On heavy castings grits as coarse as 8 and 10 are found to give the best results when bonded with a hard and tough bond. In some foundries it is a practice to grind or finish small malleable castings in the hard before they are annealed, and for this class of work the harder abrasive, silicon carbide, has been found to be superior.

For the grinding of steel it is generally found that a harder bonded wheel is required than for malleable cast-iron. It is also found that a considerably harder wheel is required for use on a swing-frame grinder than is required for a stand-grinder operation.

For the grinding of the general run of castings found in a brass foundry such extreme care in selection of a grinding wheel is not necessary, as the same wheel, properly selected, will perform all kinds of such grinding, with the exception of perhaps straight aluminum or copper. For this class of work a softer wheel is essential.

A loose bearing, or vibration in the spindle of a grinding machine, is very liable to cause uneven wearing on the wheel. This uneven wearing of an abrasive wheel is often attributed to faults in the bonding, or unevenness in the wheel, whereas the actual source of the trouble lies in the grinding machine and not in the grinding wheel. The peripheral speed of an abrasive wheel should also be kept as nearly constant as possible and the machine speed changed to produce this effect as the wheel is reduced in diameter by wear.

It is also very commonly found that the use of the dresser is abused in foundry practice. Wheel operators are often allowed to dress their own wheels, and if the amount of material removed by such means were carefully checked it would be found that more of the wheel was lost from this source than by the actual grinding operation. By placing the care of abrasive wheels under a competent man it has been shown in numbers of cases that as much as 150 per cent. increase in the life of an abrasive wheel can be obtained. If it is absolutely necessary to frequently dress a wheel it is obvious that the wheel is not suited to the particular operation, as a correctly-graded wheel should not require frequent use of the dresser.

The Institute of Commerce.

An influential gathering of representatives of British and Colonial industries met at the Savoy Hotel, London, on October 8, for the purpose of inaugurating discussion of the proposed Institute of Industry and Commerce, which is being established for the encouragement and promotion of British industry and commerce.

Mr. J. Taylor Peddie presided at the luncheon, and those present included Lord Aberconway, Mr. G. Mure Ritchie, Col. J. S. Wright, Sir E. H. Holden, Sir J. Heath, Sir R. Hadfield, Mr. E. Parkes, M.P., and Mr. C. J. Fairfax Scott.

The Chairman explained the principles upon which the institute is being formed, and emphasised the supreme necessity of organisation among the manufacturers and merchants in Great Britain, for the purpose of expanding the trade of the Empire and of taking full advantage of all the conditions arising out of the war. Among the principal general questions which required attention, he said, were the increase of banking credits in so far as they affected industry; the establishment of an efficient commercial Consular service, kept directly in touch with the requirements of British manufacturers; the careful investigation of railway and freight rates; and the securing of large contracts for this country, which were, in many cases, a result of the large loans floated on the London market. The proposed institute would have an executive selected by trade organisations and an honorary president and vice-presidents should be elected from men pre-eminent in industrial life.

Sir Charles Macara, Sir George Reid, Earl Grey, and Lord Aberconway addressed the assembly in support of the Institute. Mr. C. J. Fairfax Scott, secretary of the British Iron Trade Association, urged the need of a reorganisation of our Consular service, and the employment in that service of thoroughly trained business men. In conclusion, the resolutions were proposed and carried forming an organising committee to take steps to incorporate the Institute.

Selection of Electric Motors and Controllers for the Foundry.*

By S. H. Libby.

The selection of electric motors and controllers for foundry use presupposes the selection of the proper kind of electric energy to suit conditions, and while alternating current is in many cases as well adapted for foundry work as direct current, there are places in which the direct-current motor has a distinct advantage over the alternating-current motor. As a study of the different uses to which the motor is to be put will best show the requirements, the requirements for crane motors will be investigated, assuming first that direct current is available.

The voltage at the conductors is, of course, immaterial as far as operation of the motors is concerned, but should preferably be 230 volts, as at this voltage insulation is not as hard to maintain nor the danger as great as at 500 volts, and the cost of copper in the conductors is appreciably less than if 115 volts were used.

In all probability there is nothing as indefinite about a crane or hoist as the rating given to the motors by the various crane builders, one size frame, for instance, being rated at any point between 5 and 15 h.p. As ordinary crane service is far more intermittent than the duty in the majority of cases where electric motors are used, the motor may, of course, be rated higher than if used for other duties. For ordinary crane work it has been found that a rating based on a half-hour run with a rise in temperature not to exceed 55 deg. C. is conservative. If, however, the duty becomes more continuous the rating must be changed accordingly.

For ordinary uses the speed of the apparatus has little to do with the selection of the motor, but for hoist duty, particularly where patterns are to be drawn or copes lifted, the results to be obtained depend to a very great extent on the proper selection of the motor and control. As it is possible to handle light loads at much higher speeds than heavy loads, the empty crane hook should be capable of being raised or lowered at a much greater speed than the full-load speed, thus effecting a saving of time and increasing the efficiency of the cranes. Experience appears to indicate that a no-load speed of double full-load speed is very satisfactory, and easy to obtain with a properly-designed motor.

In considering the hoisting and conveying of material, it is found that the duty is analogous to railway work in that the motor must start and accelerate under full load, and for that reason a series motor is desirable. For hoisting and conveying the series motor is not only well adapted on account of its high starting torque and simplicity of control, but also on account of its tendency to speed up under no-load, resulting in an increased speed of the empty hook, thereby reducing the time required to complete a given cycle of operations.

If the motor is designed to give a no-load speed of double that of full-load, the high speed will not be so great as to result in damage to its rotating parts, and if it is correctly proportioned magnetically and otherwise, the highest peripheral speed will not be dangerous.

* Paper read before the American Foundrymen's Association, Chicago, U.S.A., September, 1914.

Fig. 1 shows the characteristics of a typical crane motor, the speed of the armature being plotted against the load on the hook. It will be noted that while the full-load speed of this machine is 1,000 r.p.m. the three-fourths load speed is 1,100 r.p.m., the curve showing a fairly straight line and nearly equal increase in speed from full load to one-half load, but at a point between one-half and one-fourth load the direction begins to change until that portion of the curve lying between one-fourth load and no-load has become more nearly vertical and the change in speed is much more rapid than the change in load. This curve is taken from the characteristic curves of a line of crane motors which have proved very successful in service.

The crane motor should also combine another of the characteristics of the railway motor in that it

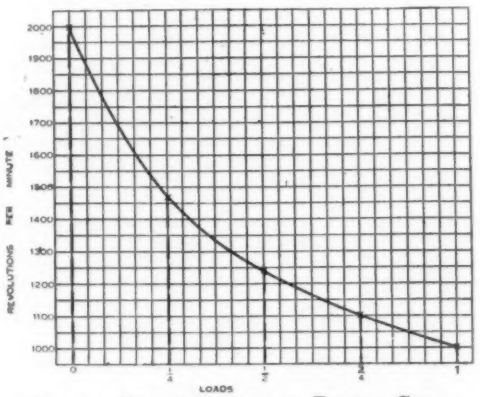


FIG. 1.—CHARACTERISTICS OF TYPICAL CRANE MOTOR.

must be weather-proof, thus insuring the protection of its interior from the moisture and fine dust prevalent in foundries. For this reason the doors should fit the motor brackets by means of machined joints. Crane motors should also, like the railway motor, allow of the fixing of the brushes at one point and the reversal of the motor without undue sparking.

An analysis of the requirements in foundries indicates that two general types of control are necessary, one for handling flasks in the flask yard, or for handling coal, coke, pig-iron and sand; while the other is for use in the moulding shop for drawing patterns, lifting copes, and pouring off. If these two requirements may be satisfied with one controller combining the two types, the problem is simplified. For the first type a rheostatic controller will be sufficient. Such a controller should allow of lifting half-load on the first notch, at one-quarter to one-third full-load full speed. This will mean an arrangement of resistance which will allow of 75 per cent. of full-load current flowing on first notch when the motor is at a standstill. Such an arrangement will give sufficient allowance for overcoming the

starting friction of the entire machine and also for acceleration.

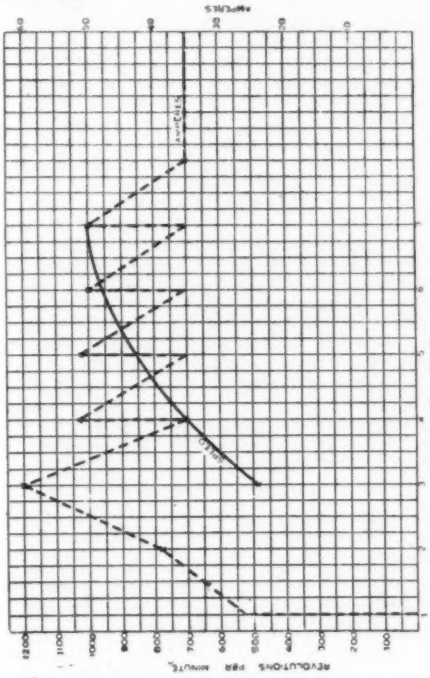


FIG. 3.—CURRENT AVAILABLE FOR ACCELERATION.

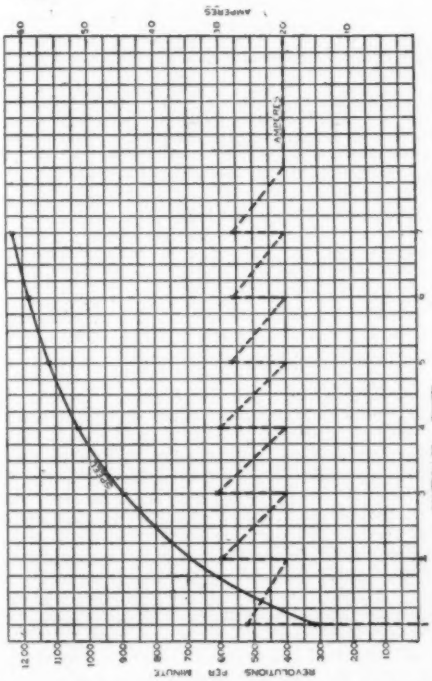


FIG. 2.—SPEED AT ONE-HALF LOAD ON SEVEN-POINT CONTROLLER.

Fig. 2 is plotted to show the speed at one-half load on the various notches of a seven-point controller, from which it will be noted that the approximate full-load speed is reached at the fourth notch. This curve also shows the rush of current as the controller is turned to each successive point, the lower point of the curve denoting the running current for half-load, the difference between that point and the upper point denoting the current utilised in acceleration. Taking full-load, which requires approximately 35 amperes, it could not be started on the first notch, as the maximum current on that step is only 26 amperes. Turning the controller to the second point gives a current of 39 amperes, and as the running current is 35 amperes the difference of four amperes is not enough to overcome the static friction and accelerate the load, and the controller must therefore be turned to the third point. A reference to Fig. 3 shows that the first rush of current on this point is 60 amperes, leaving 25 amperes to start and accelerate. This curve also shows the current on the different points which is available for acceleration. From these curves we find that a variation may be obtained from half-load at about quarter speed, to full-load full speed, which variation is entirely acceptable for crane work falling within the first requirements mentioned, but it would be entirely inadequate in fulfilling the second requirements.

Suppose, for instance, it is desired to draw a pattern which may reasonably be expected to weigh at most not more than one-fourth of full load; the results if the attempt is made with the rheostatic controller are shown in Fig. 4, where the slowest speed is more than 75 per cent. of full-load full speed. It will probably be said that the first point of resistance may be so changed as to allow of

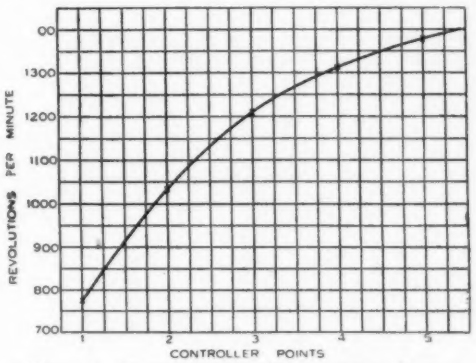


FIG. 4.—SPEEDS WITH ONE-QUARTER LOAD.

handling light loads at slow speeds. This is true, but in changing to accommodate the light loads we have spoiled its use for half or similar loads. Assuming a required starting current of 33 per cent. over the running current, and one-fourth load to lift, the current at start must be 18 amperes and drop to 13 amperes at the end of the accelerating period, and with resistance so arranged as to produce those results half-load could not, of course, be started on that point, and it would therefore be necessary to use the second point for starting that load, thus adding another point to the controller. One-quarter load, however, is a rather heavy allowance for the pattern in most cases, so that a still smaller load could be handled on the first point, say one-eighth load. This would require approximately seven amperes running current and 9.5 amperes to start, including acceleration, which would mean that one-fourth load must start on the second point and one-half load on the third point, thus adding two points to the controller and making it necessary to "feel" the controller along until the point at which the load will start is reached.

This not only results in a cumbersome controller, but in a loss of time if the moulder is also the hoist operator, as in the case of light work with floor control, where the hoist is intended as additional

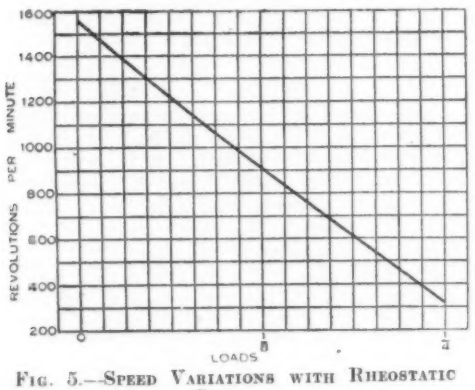


FIG. 5.—SPEED VARIATIONS WITH RHEOSTATIC CONTROL.

equipment in the moulder's hands to expedite his work. Again, the great variation in speed on the same controller point, with a change in load, may result in bad work, not only on account of too high speed for drawing patterns and lifting copes, but also on account of the sudden increase in speed as a sticky flask becomes free.

Fig. 5 shows what may be expected of rheostatic control when such a change in load occurs. This curve shows the speed of smaller loads when run on a controller point designed to give one-quarter speed at one-quarter load.

It is very evident then that the rheostatic controller is not the ideal controller for use in the moulding shops, particularly because it does not give a sufficiently constant speed with a wide range of load on the first notch, and it is necessary, there-

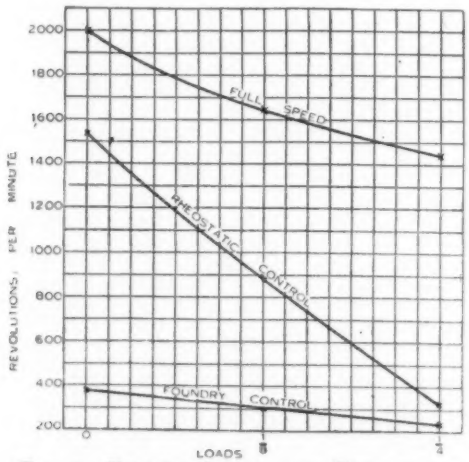


FIG. 6.—FOUNDRY CONTROL AND RHEOSTATIC CONTROL CONTRASTED.

fore, to find something which will show different characteristics. What is desirable then is a controller which will approximate as nearly as possible on the first notch the constant speed characteristics of the shunt motor, and yet retain the series motor characteristics on the other points. With a properly-designed motor this may be accomplished by arranging a resistance in shunt with the armature in addition to a series resistance. Fig. 6 shows the characteristics of such a motor for so-called foundry control and also for rheostatic control. It will be noted how much flatter is the curve for "foundry" than for the rheostatic control, showing comparatively little change in speed from one-quarter-load to no-load. This comparatively small change in speed is, of course, desirable, for it means that in drawing a pattern which weighs one-eighth of full-load this speed would only be 60 per cent. higher than if the weight was one-quarter of full load. Or, in other words, if the speed at one-quarter load were 2 ft. per minute, the speed with one-half of that load or one-eighth full load would be 3.2 ft. per minute, not a prohibitive speed and one easily controlled, as the operator has only to turn the controller to the first point and he gets the proper speed for all loads within a wide range without juggling the controller.

In this particular class of work the direct-current motor shows its superiority over the alternating-current motor, as Fig. 7 will indicate. On this curve it will be noted that the start is at a point at which one-quarter load may be accelerated, and that at

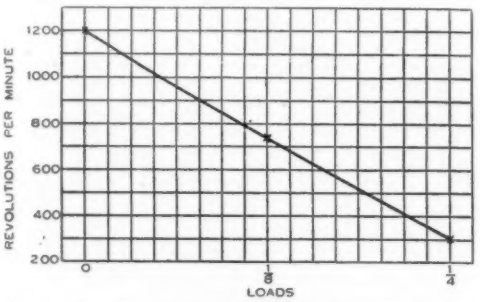


FIG. 7.—ALTERNATING-CURRENT MOTORS WITH RHEOSTATIC CONTROL.

that load the speed reaches 300 r.p.m. If, however, the load is one-eighth of full load the speed will reach about 750 r.p.m., or more than twice the one-quarter-load speed. A comparison of the two curves as to angle with the base line discloses this graphically, both curves being drawn to the same scale.

For other than crane duty the general requirements appear to be similar to those obtaining in certain heavy tool operations, such as planers, punch presses, etc., and motors which would best meet such requirements should prove satisfactory for foundry work. One characteristic which such motors should have in common with the crane motors is that of being totally enclosed, as in spite of any method of boxing or housing which is generally in vogue in foundries, the fine dust permeates to the motor and invariably results in more or less trouble. For general use on tumbling barrels, sand carriers, mixers, etc., a compound-wound motor with a series field of 10 to 15 per cent. should be used if direct current is used, as the characteristics of such a motor would enable it to keep the apparatus in motion under heavy overloads without any bad results at the commutator. Such a motor would also start a heavy load, to which it might be direct connected, such as tumbling barrels or sand conveyor, with the same absence of commutator trouble. If alternating current is being used a slip-ring motor should be specified, as such a motor will be capable of gradually starting such machines as may be loaded although not running.

In selecting motors for the general uses above described, it is quite as much of a mistake to select a motor which is too large for the work as to select one that is too small. The small motor would, of course, burn out, necessitating repair or replacement, while the large motor would not only be expensive as to first cost, but inefficient while running at small load.

In selecting controlling devices much will depend upon a careful study of the actual conditions. If a machine is to be started and stopped frequently, as would be the case of a lathe or planer, an automatic or push-button control, of which little is generally known, would prove to be a good investment, in spite of the seeming high first cost. Such a control not only eliminates the results of carelessness or ignorance on the part of the operator, but also has the added advantage of safety in the event of failure of current, as under such conditions everything goes to "off" position and the full cycle of operations must be performed again before the motor can be started. For ordinary uses, however, where a machine is started but a few times each day, the simpler form of controller is satisfactory. As an auxiliary equipment for motors of 25 h.p. and above, an ammeter has been found to be of considerable value in detecting increased load due to lack of lubrication, to faulty adjustment of the driven machine, or to a tendency of operators to overload the machines. Such a device would also show if the motor were too large or too small, and so allow of a change in the equipment to give better results.

Statistics of American Foundries.

According to statistics compiled by our contemporary, "The Foundry," on August 1 a total of 6,507 plants were engaged in the production of grey iron, steel, malleable cast iron, brass and aluminium castings in the United States and Canada, as compared with 6,538 on July 1, 1912, a loss of 31 shops. In view of the unsatisfactory trade conditions which have prevailed for a period of practically two years and the tendency toward the establishment of larger manufacturing units, the loss is considered to be comparatively small. Although no figures have been compiled on capacity and production, the consumption of foundry grades of pig-iron indicates a large increase in the output of grey iron and steel castings during this period. On April 1, 1910, there were 6,594 foundries in the United States and Canada, and in 1908 the total number of casting plants aggregate 6,366.

During the past two years many shops have greatly increased their capacity and the number of new plants built is in excess of 500. In 1906, 6,108 casting plants were in operation in the United States and Canada, but the decline in the number of individual firms dates from 1910, inasmuch as during the preceding four years there was a steady increase in the number of shops.

In the compilation of these statistics, each plant was considered as a unit, regardless of the number of casting departments it contained. All of the side-blow converter plants operate grey-iron departments, as the iron first is melted in the cupola before it is charged into the converters. Also, practically all of the malleable shops melt grey iron for making annealing boxes, and the brass departments of grey-iron, steel and malleable shops far exceed the foundries that melt brass, bronze and aluminium exclusively. Considering each department as a unit, there were 9,421 casting plants in the United States and Canada on August 1, 1914, as compared with 9,158 in 1912, a gain of 263. In 1910 the number of casting units, figured on the foregoing basis, was 9,158.

A statement of the total foundries in the United States and Canada in 1914 is given in the accompanying table :—

Foundries in the United States and Canada by States and Provinces, 1914.

	Total foundries.	Grey iron foundries.	Exclusive brass foundries.	Brass foundries departments of other shops.	Total brass foundries.	Malleable iron foundries	Steel foundries	Foundries melting aluminum.
UNITED STATES :—								
Alabama ..	93	88	5	36	41	1	4	19
Alaska ..	2	2	—	2	2	—	1	1
Arizona ..	9	9	—	9	9	—	—	6
Arkansas ..	23	22	1	19	20	—	—	10
California ..	165	130	30	89	119	4	9	86
Canal Zone ..	1	1	—	1	1	—	1	—
Colorado ..	47	40	7	20	27	—	2	16
Connecticut ..	167	88	72	41	113	11	3	62
Delaware ..	17	10	3	6	9	1	5	3
Dist. of Columbia	11	7	3	4	7	2	2	5
Florida ..	16	14	2	14	16	—	—	11
Georgia ..	81	76	5	56	61	2	3	29
Hawaii ..	3	3	—	2	2	1	1	1
Idaho	13	12	1	12	13	—	—	7
Illinois.. ..	453	338	98	117	215	26	20	149
Indiana ..	244	189	42	85	127	10	13	74
Iowa	116	105	7	53	60	2	6	42
Kansas ..	52	46	5	29	34	1	—	29
Kentucky ..	62	51	11	23	34	1	1	21
Louisiana ..	41	36	5	26	31	—	4	9
Maine	45	38	7	27	34	2	1	17
Maryland ..	62	45	17	23	40	1	2	22
Massachusetts	282	177	95	68	163	7	12	111
Michigan ..	343	241	84	118	202	11	17	134
Minnesota ..	109	94	12	59	71	1	7	46
Mississippi ..	23	23	—	20	20	—	—	8
Missouri ..	143	107	31	63	94	2	6	61
Montana ..	11	9	2	8	10	—	—	6
Nebraska ..	20	24	4	20	24	1	—	21
Nevada ..	4	3	1	3	4	—	—	3
New Hampshire ..	36	29	7	14	21	1	—	14
New Jersey ..	228	157	62	61	123	5	8	68
New Mexico ..	3	2	1	2	3	—	—	1
New York ..	597	426	159	206	365	22	14	225
North Carolina	74	66	8	55	63	1	1	34
North Dakota .	5	5	—	5	5	—	1	3
Ohio	634	433	164	161	325	29	29	196
Oklahoma ..	29	27	2	22	24	—	1	14
Oregon ..	43	37	4	25	29	—	2	19
Pennsylvania .	848	652	141	290	431	24	78	265
Rhode Island .	42	24	16	11	27	—	1	16
South Carolina.	29	28	1	23	24	—	—	14
South Dakota .	6	6	—	5	5	—	—	3
Tennessee ..	91	83	7	44	51	1	3	34
Texas	73	61	12	43	55	—	2	30
Utah	18	17	1	14	15	—	1	12
Vermont ..	28	25	3	19	22	—	—	11
Virginia ..	89	87	2	58	60	2	3	34
Washington ..	91	79	11	60	71	2	12	47
West Virginia .	51	45	4	29	33	2	3	13
Wisconsin ..	259	190	47	95	142	20	20	87
Wyoming ..	1	1	—	1	1	—	—	1
Total in United States .	5,942	4,574	1,202	2,296	3,498	196	299	1,850
CANADA :—								
Alberta ..	13	10	3	10	13	—	1	8
British Columbia	21	19	2	17	19	—	1	9
Manitoba ..	14	12	2	6	8	—	—	6
New Brunswick	23	19	4	15	19	—	—	6
Newfoundland	2	1	1	—	1	—	—	—
Nova Scotia ..	33	31	1	20	21	1	2	8
Ontario ..	341	286	40	143	183	13	7	102
Prince Edward Island ..	3	3	—	3	3	—	—	1
Quebec ..	109	97	11	50	61	4	7	33
Saskatchewan .	5	5	—	5	5	—	—	3
St. Pierre Et. Miquelon ..	1	—	—	1	1	—	1	—
Total in Canada ..	565	483	64	270	334	18	19	176
Total in United States and Canada	6,507	5,057	1,266	2,566	3,832	214	318	2,026

Core-Boxes and Core-Making.

By D. Gordon, A.M.I.Mar.E.

(*Continued from page* 579.)

As already described, circular cores of varying diameters are struck up by means of the core lathe, but cores thus formed are not limited to variations parallel with their cores axes. Following out the principles involved, it will be seen that if the board profile be cut to strike up variations transversely to the axis the procedure is obviously the same. When ribs, bosses, etc., are required at these transverse positions they are bedded in at their respective situations, very frequently by means of a skeleton carrying-frame, but in the simpler examples marking off upon the core is depended upon for position-

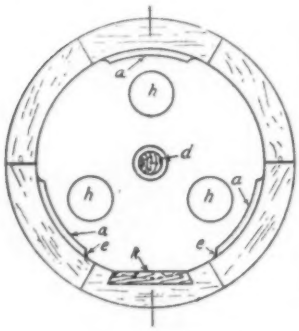


FIG. 31.

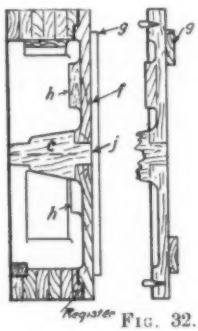


FIG. 32.

ing. Neither of these methods gives those accurate results so highly desirable in modern core practice and frequently work of the character described is preferably made within boxes. The writer will now deal with methods of making various types of the shallower or lighter of these boxes. The principles involved are applicable in every way to the heavier type of box, excepting that the purely cylindrical form of the box would be lagged up, and not built up as in the examples given. Further, instead of attaching the lags by means of "bridges," as described for Fig. 20, the general method is to adopt top and bottom framings, which are half-lapped or morticed together; but to avoid unnecessary repetition these methods will be dealt with in connection with their application to work other than truly circular.

FIG. 33.

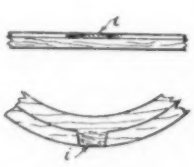


FIG. 34.

Fig. 31 gives the elevation and sectional view of a circular core box for a gear case which contains around its periphery three facings, *a*, *a*, *a*, and upon one face three bosses *h*, *h*, *h*, with a bearing hub *c* from which projects a bearing print *d*. This type of box, in its main body, is invariably built up in segments and jointed centrally to allow for the easy relief of the core, but more especially, in this example, to avoid the pieces *a*, *a*, *a*, being made to work as loose pieces, which latter are most frequently the source of trouble and annoyance. In this example the facing fillets at *e*, *e*, would have to be "worked," so that when the half portions of the box containing them are drawn apart the release of the box at these positions leaves the core without fractures. The bottom of the box *f* is made up from the solid material, being strongly battened (as at *g*) upon its lower surface and is preferably made to contain those fillets which can be conveniently turned out of its substance. In this respect the

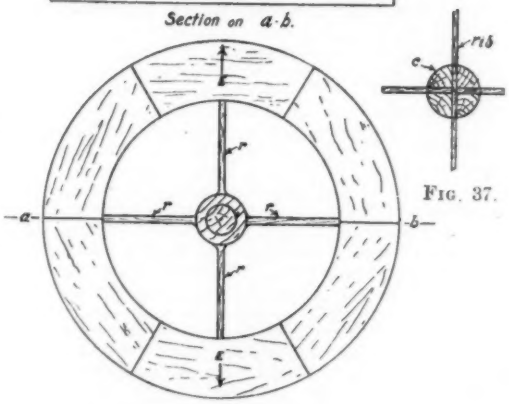


FIG. 35.

FIG. 37.

bearing hub *c* fillet, with also the encircling fillet for the main body portion, are easily and quickly formed in the lathe; but the bosses *h*, *h*, *h*, with their fillets are positioned as separate units. The forming of their fillets from this bottom plate would entail considerable time and labour which would not compensate for the disadvantages created by having "feather" edges. When possible and within limits feather edges should always be avoided, as no matter how firmly attached they are initially, they invariably rise at their edges, causing the core to be disfigured or broken.

The most common method for attaching bottom plates which are required to be separate units to the main body portions of circular boxes is to form a turned-up register, as it will be quite obvious that this can be accurately and expeditiously done

during the turning operations for each part, trials over by the first turned portion until relative fits are obtained being a simple matter. Another consideration obtained by this registering is that the main body portions can be relieved from the core without disturbing the bottom plate. When dowels are used in place of a register, the main body portions are locked together, which is often an advan-

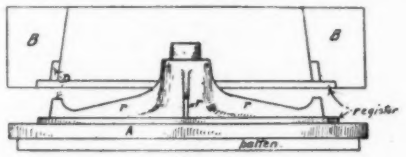


FIG. 36.

tage, but the core's relief must then of necessity be obtained by first withdrawing the bottom plate. If dowels are used care must be taken that their position is not affected by any slight shrinking or swelling of the plate material, which, of course, reacts immediately upon their fitment. In Fig. 32 their positions in respect to their grain are indicated by assuming the battens *g* to be placed transversely to the grain. If dowels only are used the relative positions of the bottom plate with the main body are definitely fixed, but with a turned form of register this is not so, and in some cases a dowel is used to define position, or a stop piece *i*, Fig. 34, is made to abut the projecting portion of one part of the box register and is a sliding fit in the other, which is cut to receive it. These stops are made tapered to ensure easy relief.

It will be noted that the bearing hub *c* (Fig. 31) is fixed to the bottom plate by means of a spigot *j*, this method being the best to adopt for ensuring rigidity, with also simplicity in fixing, when parts are in any way of excessive height and of a turned character.

Fig. 33 gives an illustration of the formed core. After being rammed up the box is inverted upon its

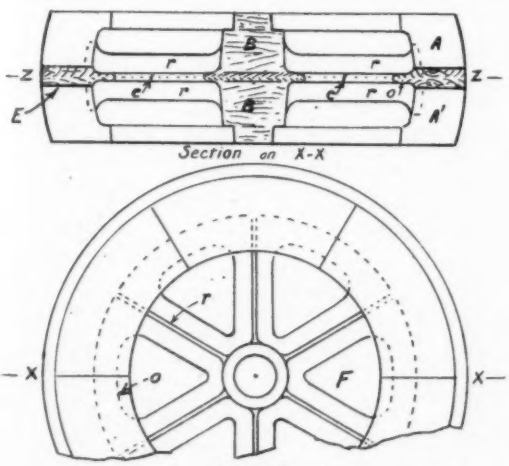


FIG. 38.

core plate, and the bottom plate of the core box is first removed, the sides being afterwards drawn apart. The position of circular cores in their relation to the mould in conjunction with which they are used, is defined generally by a "flat" cut upon the core print on the pattern, and which flat is formed at the corresponding position upon the core. Reverting to Fig. 31, the flat required as at *k* would, for the example in question, be permanently fixed by being fitted to the circular main body as indi-

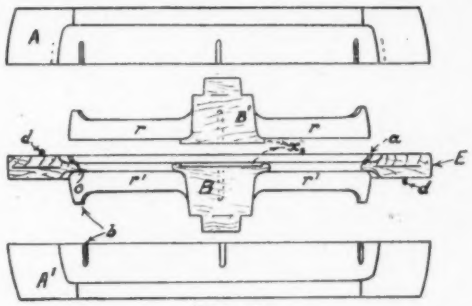


FIG. 39.

cated by the dotted line, but if it be assumed that the core is to be "dropped" out, the flat would be required to work loose. In some cases skewers would be utilised for this purpose, the skewers being withdrawn after the position of the "flat" loose piece had been assured in the sand.

Another method is to make the loose piece to be a sliding fit in the main body, as shown in Fig. 31, when it will be noted that it is of a dovetailed form, this formation giving a slight initial bind with an after easy withdrawal. This latter method of attachment has its obvious advantages, but is slightly more costly to produce than the simpler skewer attachment.

The advantages derived from making core boxes in loose parts lie chiefly in the fact that the core

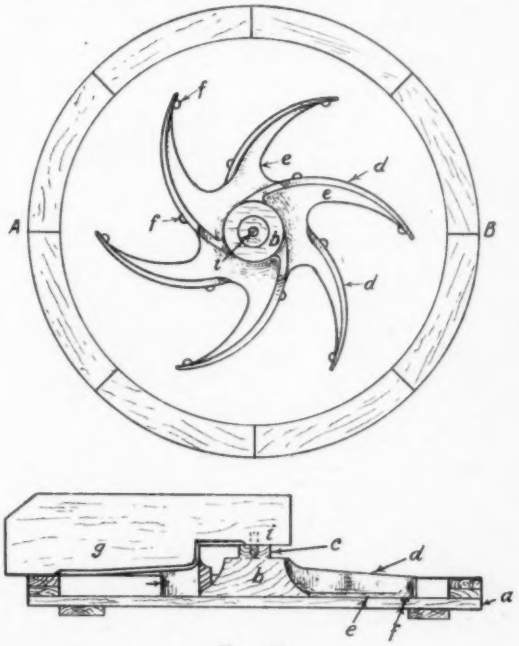


FIG. 40.

can be more readily relieved; but care has to be taken that the advantages are not obtained at the expense of a weakly-constructed box. In this

respect the multiplication of loose parts and pieces tends to continual replacements, owing to their being lost or broken, or through insufficient stability, allowing the ramming to produce a distorted and inaccurate core. When boxes in loose parts are considered advantageous, as distinct from being necessary, the extra cost due to this procedure must compensate for the extra expense involved, as it is inevitable that a box made in parts which combine together to form a complete whole, takes considerably longer to produce. In many cases it is, of course, absolutely necessary to part the box in two or more pieces, this occurring generally when a "drop-out" of the core is otherwise not obtainable.

An example of the latter class is given in Fig. 35, which depicts the core box for the interior of a ribbed clutch wheel. This class of box, which is segmentally built up in its body, with a bottom plate made to contain the peripheral fillet and also the rise towards the centre hub *c*, is, owing to its taper, opposed to a "drop-out" of its core; consequently the bottom plate to which the ribs *r*, *r*, *r*, *r*, are attached as fixtures, is made to work as a separate part from the main body *B*. Its position is defined both by a register joint and also the ribs which are recessed into the main body as sliding fits. This box could with advantage be made to also part along the centre *a*—*b*, to assist in relieving the core.

FIG. 41.

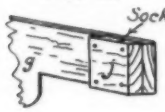
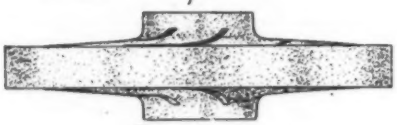


FIG. 42.

FIG. 43.



To consider this more fully, if the part *B* be made as one continuous piece, and it be first removed after the core has been rammed up within it upon the bottom plate, the core is left unsupported around its circumference when turned over; and, further, when removing the bottom plate *A*, to which the ribs, *r*, *r*, *r*, *r*, are attached, with also the hub *c*, the possibilities of fracture when removing this latter are very probable, even when full taper facilities are allowed. If, on the contrary, the body part *B* is parted centrally and held together with pinch-dogs, the core when inverted (within the complete box) has full circumferential support when the bottom plate *A* is removed, and the drawing apart of the main body pieces in the directions E, E, leaves the core ready for immediate stoving for drying. It will be obvious that if the body piece *B* were not removed in the first instance when made as one continuous piece a double turn over of the core would be necessary—a proceeding only permissible when the core is of small diameter and allows freedom in handling.

Referring to the recessing of the ribs as at *D* (Fig. 36) into the body *B*, *B*, the advantages gained by so doing are that short grain is avoided at the ribs' extremities, and no dowel or stop is required for locating relative positions; but if five or more ribs were required, then their recessing into the part *B* would depend entirely upon the methods adopted for relieving the core. With reference to the constructive methods for fixing ribs or webs as *r*, *r*, *r*, *r* (Fig. 35), these are generally made as surface fitments to the bottom plate *A* and the hub *c*, and are glued, screwed or nailed into position, their fillets being made by means of leather, wax, etc., in the heavier types, though when of a light section the fillets at both extremities are cut from the solid material, their base fillets being made up. In these latter instances the ribs are recessed at both extremities into the material.

Another method for combining ribs or webs of an equal number, but not applicable to the example shown in Fig. 35, is to check over the material where it crosses, a boss or hub being made up by means of corner blocks *c* (Fig. 37). This method is adopted when the ribs fit upon a level bed and the hub or boss is of a small diameter, but would not be adopted, owing to the labour involved, when the bed upon which they have to be fixed is not level or uniform.

In general practice if one box can be utilised for producing two cores to form a complete core this method, for economical reasons, is adopted; but in these cases the joint has to be of such a nature that the inaccurate setting of the half cores one with the other is highly improbable. As the accurate jointing of two half cores cannot always be achieved by means of core-print flats (as shown at *k*, Fig. 31), or by markings upon the respective half cores, it is more satisfactory to make up a complete box and by judiciously parting it attain complete accuracy.

Fig. 38 gives the sectional elevation and plan views for coring out a shrouded wheel whose arms are of + section. This core if split centrally through *Z*—*Z* would give two duplicate cores, but their correct return to position would be a very questionable proceeding, owing to the difficulty of correctly defining the respective positions of the arms one with the other, if made in a box suitable for producing one half of the core only. It follows that when jointing takes place, the greater part of the central work, *i.e.*, the ribs, etc., would be hidden, and the disadvantage of this procedure when jointing half cores requires no further comment. A full box would produce cores more conveniently and accurately, and would best be made up in four parts as shown in Figs. 38 and 39, where *A* and A^1 would be built up in continuous rings, and would fit upon the two surfaces of the intervening centre plate *E*.

The plate *E* would be made up in segments to form the interior flange *O*, and would receive into it, by means of half-lapping or housing, those portions of the six arms upon the same plane, and which latter where they cross would be checked over each other to the amount of one-third their thickness. The completion of the arms would be made up by attaching, as fixtures, the ribs r^1, r^1 to the plate at their respective positions. These ribs might advantageously be checked over each other, as their full length would tend to strengthen up those portions of the arms which are transverse to them, and in this event the hub or boss *B* would be made up with corner blocks as explained for Fig. 37. Alternatively they could be let into the boss *B*, but in both cases the ribs' extremities would be recessed into the main portions *A*, A^1, as sliding fits. The remaining portion of the arms to form the complete + section would, from a convenient core-making point of view, be made to work as a loose part off the centre plate *O*, the ribs *r*, *r* being checked over each other for attaining greater strength. These ribs at their extremities would be sliding fits into both the plate *E* at *a*, and also into the body part *A*. To avoid feather-edges at the base of the boss B^1, this latter at this position would be thickened up and registered into the centre plate *E* as shown at *x*. The positions of the respective parts would be defined by means of dowels *d*, excepting the loose part

r—r, whose positions would be defined by the recesses in both the centre plate *E* and body part *A*.

To make up this core the box part A^1 with the centre plate *E* placed into position with it, would be rammed up to the level of the arms at c—c (Fig. 38). The sand at those positions which form the spaces *F* between the arms would, at their several central positions, be dipped out and parted over. The loose part r, r, would then be assembled, with also the remaining part *A* and the complete core made up. To relieve the core the box part *A* with the bedded-in part a, a, would be lifted with the one half core within it and which when inverted would allow the loose part r to be withdrawn. The other half-core would be relieved in a similar manner, differing only in the respect that the centre plate which carries the arms would be cleared as one unit. The joints of the core, *i.e.*, those positions which form the spaces *F* between the arms, would be parted over and their relative positions defined by means of dips made in the one half of the core, forming sand risers in the other when rammed over it, forming thus a series of dowels for allocation purposes.

Another method adopted to ensure joint accuracy in work of this description is to have the dowels in one main body part of the box, as at *A* (Fig. 39), sufficiently long to penetrate through the centre plate *E* and fit into the other part A^1. In these cases no dips or risers upon the core joints are necessary. This method is applied in many ways—as for example, projecting strips fitting around and into the box at its extreme position—and any of these means give results of an entirely satisfactory character.

The making of cores partly by means of boxes and partly by strickles is frequently adopted, and this procedure is simple, economic and efficient. The application of strickles in conjunction with circular core-boxes is to save the making up of another box part whose core, if of a uniform character and made up around a common centre, is in every way unnecessary. The procedure for the strickles' use is similar to that adopted for striking up a core by means of a spindle and board, but differs in that the core-box is the foundation or building plate upon which the core is formed. Apart from the economies secured by the combined use of box and strickle, another important reason for adopting this combination is that the core-box is more accurately and conveniently the bearer of the various details which go to make up the core than would be the case if a building plate and spindle only were utilised for the same purpose. Further, when the core is made initially in the green sand, compactness and stability are given to the main structure—a great consideration when a dry-sand core is required by struck-up means

An example explaining the method involved in this class of core-making and incidentally explaining a method for the attaching of curved pieces, which are conveniently, but not of necessity, made to work as loose portions, is given in Fig. 40. Here are given the full plan view of a core-box required for an impeller disc half-core, and section through A—B. The circular body of the box is built up in segments and permanently attached to a bottom plate a, upon which the boss b with the bearing print c is fixed.

The centre ribs e of the impeller are also affixed to the bottom plate, and are cut to allow the vanes d—d to abut against them at their respective positions. These vanes are usually made of metal, a pattern being required for their production, this being in the majority of cases necessary, owing to their light sectional thickness with a fine projection, as will be noted at h (Fig. 42). They are also made to work as loose pieces so that when the core is withdrawn from the box the box-bind is considerably lessened, and they are withdrawn separately. The positions are defined and maintained by means of "buttons," f, f, which latter are circular in form and project from the bottom faces as shown in Fig. 42. In the bottom plate a holes are drilled to receive them, and as another half-core of opposite hand is required, vanes of a reverse curvature are necessary with also the holes for their reception. The upper surface of this core is required to be in line with the edges of these vanes and level from their extremities outwards. This is done by means of a striking board g, which is made to revolve centrally off the print c and bear upon the vane edges and the box circumference surface. The method of fixing the board g for strickling purposes usually involves a dowel, the peg of which fits into a centrally-placed socket as shown. Another common method is to have a projecting peg off the print c, which peg is received into a socket hole made up by cutting a semi-circle in the board g and completed by a piece j. This latter method brings the surface of the striking board and consequently the striking edge in line with the peg centre, the board thus being required to be chamfered along the one edge, as distinct from the example in Fig. 40, where the striking line of the board, being at a central position, necessitates the board being chamfered along both edges.

The half cores are made up with a star-shaped grid bedded into each half, and when rammed and struck up are inverted upon a sand bed and the vanes (Fig. 42) removed. The half cores are then dried, pasted upon their joints and, after being combined, wired through the grids in each half core (Fig. 43). As will be quite obvious, the vanes must be very accurately set so that their surface continuity, when they are placed together, requires no "carding," a very questionable and difficult procedure in an example of this kind.

THE RENNERFELT FURNACE.—At the Malmo Exhibition the Aktiebolaget Electriska Ugnar, of Stockholm, who control the above furnace, exhibit the following list of users of their furnace:—

Name.	Capacity. Kg.	Kw.
Bultfabriks A.-B., Hallstahammar	300	80
" " "	300	80
" " "	1,250	200
" " "	1,250	200
A.-B. Stridsberg & Biörck, Trollhattan ..	600	120
Ljusne-Woxna A.-B., Ljusne	600	150
Wirsbo Bruk, Wirsbo	600	125
Imperial Russian Military Automobile Works Petrograd	300	80
Abjörn Anderssons Mek. Verkst. A.-B., Svedala..	600	125
A/S Drammens Jernstöberi & Mek. Verksted, Drammen	600	150
Ludwig Nobel A.-G., Petrograd	2,500	250
Ljusne-Woxna A.-B., Ljusne	3 000	350
" " "	1,250	200
Sandvikens Jernverks A.-B., Sandviken ..	900	175
Söderhamns Nya Verkst. A.-B., Söderhamn ..	600	150
Edgar Allen & Co., Ltd., Sheffield	1,250	200
A. Kenrick & Sons, Ltd., Birmingham ..	900	175
Mild Steel Castings, Ltd., Birmingham ..	1,250	200

The furnaces in question are largely employed for steel castings. The Bultfabriks A.B., the A.B. Stridsberg and Biörck, and Edgar Allen & Company, Limited, also use the furnace for tool steel, while the latter company further employs it in the manufacture of manganese steel. The Ludwig Nobel, A.G., employs the furnace in the refining of fluid steel charges. A description of the furnace was included in a Paper by Mr. Axel Sahlin on "The Use of Liquid Ferro-Manganese in the Steel Processes," submitted for reading at the Autumn Meeting of the Iron and Steel Institute.

Ganister Lining in Side-Blow Converters.*

By John Gregson.

A remarkable run was made recently by the Sivyer Steel Casting Company when using a complete ganister lining in its one-ton converter. Twenty-three blows were made in a single day; 30 blows were made in two consecutive days the following fortnight; and 203 blows in 13 blowing days in June.

The vital problem in side-blow converter practice is the lining, and it must never be forgotten that the lining of a converter has to be more than heat resisting. The fact that silica bricks are used in open-hearth furnace construction is no indication that they are the best material for side-blow converters. The function of an open-hearth roof is to reflect heat, and it is never called on to stand the cutting action of the oxides formed during refining. The converter lining, on the other hand, must resist a greater absolute temperature than the open-hearth roof and at the same time be subjected to direct contact with the oxides. The actual conditions under which the oxides are formed are different in the two furnaces. In the open-hearth the source of temperature is a gas or an oil flame and the reactions take place slowly under the eye of the melter, the amount of heat given off by the oxidation being negligible. Consequently the furnace is always hotter than the bath. In a converter, the forming of the oxides produces the temperature and the reactions are quick. Also the heat, after the carbon flame, is augmented by the burning of CO to CO_2 and is far greater than in an open-hearth furnace. Hence the converter lining is at a lower temperature than the bath and subjected to a more severe test than is the lining of an open-hearth furnace. Furthermore, in a one-ton converter, owing to the smallness of the bath and the consequently more rapid changes in the metal level, the reactions have a much more marked effect on the lining than in larger converters.

For three months after the installation of a one-ton converter the practice was standard. The converter was lined with silica brick and brick tuyeres were used. The bottom was knocked out at the end of each blowing day. Repairs were made with a mixture of silica grits, silica moulding sand and fireclay. With that practice, eight to ten blows a day were made, and all the metal was taken from the converter in hand shanks. As time went on it was observed that the amount of repairing material used was increasing from day to day. In chipping away the slag, pieces of brick were frequently loosened up and fell out, until finally there were no bricks left just above the slag line and on the back side. Burns through occurred and heats were scrapped.

It was decided to try a ganister mixture for repairs, and one was procured with a rock base that ran about 99 per cent. silica, crushed and mixed with specially prepared fireclay. The first day's trial proved conclusively that the move was in the right direction, and a ganister lining throughout the converter was substituted for the original one of brick. This new lining held up so well that it was found practicable to leave the bottom in for two or three days. By running the blower at low pressure for three or four hours at night, the converter was cooled sufficiently to allow a man to stay inside long enough to affect small daily repairs, and an average of ten blows was easily maintained. At that time more metal was needed, and to speed up operations the finished metal was poured into a large ladle and shanked from that. This is standard practice, of course, in two-ton converters, but the one-ton converter was unable to stand up under the strain, with only a few minutes between blows. A repetition of the trouble originally found in the silica-brick lining took place. In order to further increase the refractory nature of the mixture, a small amount of crushed rock without any fireclay was added to the original mixture, and after a few trials a combination was secured which allowed practically continuous blowing.

These facts are brought forward as matters of interest because the use of silica brick in converters is nearly universal, and it is hard to see a reason for it unless it be that the proper ways of using ganister are little known.

Perhaps one difficulty for the beginner is the necessity of finding a substitute for the customary brick tuyeres. A plate may be made to bolt over the opening onto the wind-box, with bosses drilled and reamed to hold pipes. Great care must be taken to have the centre of the holes come in the same plane, as it is essential to have the tuyeres level and plumb when the converter stands vertical. Such a plate can be made to fit any style of converter.

The tuyeres having been set in an empty shell, patterns have to be made in accordance with the shape of the converter, for ganister must be rammed, not mudded on. In a vessel that has a removable section, permanent forms are cheapest. On a drop-bottom converter, rough lumber can be knocked together and then burned out. In any type of shell it is advisable to use the rough timber in the bottom or tuyere section, as frequently drawing out of a form disturbs the ganister around the tuyeres. The ganister itself should be put in around the forms, in small quantities, and rammed solidly and evenly with an air rammer, save at the tuyeres. At that point the greatest care must be exercised, and it is better to use the peen end of a hand rammer.

The cost of the original linings in a one-ton converter will show little difference between silica brick and ganister, but there is a big saving of time and material in the daily repairs by the latter method. When the tuyeres are badly burned away, the old pipes can be drawn out and replaced by new ones, which is a distinct advantage over the old way of ramming ganister around a stick. There is always a soft spot where the patch joins the old lining and the air gradually blows the hole bigger. In one shop where a two-ton converter with a ganister lining is used an average of eight blows, five days a week, has been maintained for months. It is frequently possible to run an entire week without touching the tuyeres, and no repairs inside the vessel save small patches on the belly. In a one-ton converter the same bottom and tuyeres often last four days with an average of thirty to thirty-six blows those four days.

* Paper read before the American Foundrymen's Association, Chicago Convention, September, 1914.

Foundry Problems, Solved or Unsolved.

By Sidney G. Smith.

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It is hardly necessary to say that problems of considerable variety arise in the iron foundry, as well as in non-ferrous foundries. Probably the iron foundry could furnish more examples of questions that require solving than could the other branches of foundry work, owing to the number and variety of classes of work made, and the complex nature of cast iron. But, thanks to research work and metallurgical investigation, many former problems are no longer such. There are still many left, and whether the number increases or decreases depends largely upon the demands of the engineer, because the simpler and more uniform the design of castings are made the less will the making of such castings be problematical. The writer is not now charging the engineer with wilfully creating difficulties for the foundry, but it is very often the case that the possession of a little elementary foundry knowledge by the engineer would wonderfully reduce the number of problems created, and would greatly assist the foundry in producing sound, durable castings.

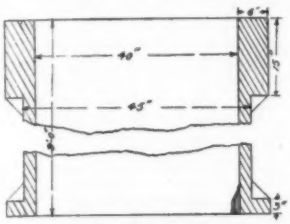


FIG. 1.

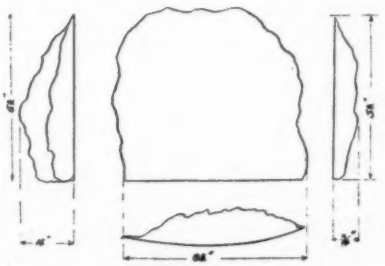


FIG. 2.

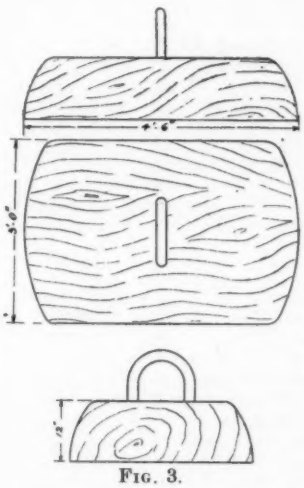


FIG. 3.

Experience has shown that under certain conditions certain occurrences will take place, and the foundryman is left very much to himself in providing ways and means to prevent or overcome undesirable results. To what extent this can be accomplished depends upon his ingenuity and resourcefulness, but however ingenious he may be, there will be limits of control, and as the foundryman is not yet superhuman, he is often found knocking his head against a brick wall.

Until recent years the foundry has practically been without any reliable literature, teachers, text books, or even theories, and it has been left to those who daily toil in the foundry to discover the cause and effect of many problematical occurrences. For instance, one finds that, according to an ordinary text book, grey iron contracts an eighth of an inch to a foot. Now, anyone of very limited foundry experience knows that to absolutely rely upon that would involve endless trouble. Especially would that be the case in a large general jobbing foundry where all kinds and classes of work of various thicknesses are made. If grey cast iron contracts $\frac{1}{8}$ of an inch to the foot, how is it that castings made from the same pattern by the same moulder, with the same care, will vary in length? But it is obviously too late in the day to put the matter in that light; it was discovered in practice many years ago that grey cast iron, in its many forms or compositions, will vary considerably in contraction, and what is more complex and important still, the variation of contraction will be also in relation to thickness.

There is a wide range of grey foundry irons, from a dead-soft open-grained No. 1 of low specific gravity, to a close-grained fairly hard No. 5 of high specific gravity. These irons differ in composition, chiefly in silicon and graphitic carbon, soft iron being high and hard iron low in these elements, and often according to the proportion of these elements so will the contraction vary. A soft high-silicon and high-graphite iron, will contract the least, and a low-silicon, high-combined-carbon iron will contract the most.

Again, apart from the composition of the iron, variations in contraction will occur in thin and thick sections, the contraction increasing as the thickness decreases, and decreasing as the thickness increases. A 12-in. cube which is cast and fed solid will not contract so much as a 12-in. square plate one inch thick. The same law applies to different circular

thicknesses, to which fact the writer has previously referred. It will be obvious that, in a general foundry, to obtain accurate sizes allowances must be made. The writer recalls certain flanged castings, bracketted, 40 in. in diameter by 9 ft. long, which varied from 1½ to 2½ inches in thickness respectively; the castings 2½ inches thick contracted only ½ in. in the 9-ft. length, the iron was close-grained and dense and the same in every casting, and as there was a large number of these castings required of the same length but of different thickness, they afforded a good example of such variation. The castings were made in loam and cast vertically, and as the thicknesses approached the 1½-in. section castings so was the normal $\frac{1}{10}$-in. contraction per foot more nearly attained.

Why an open-grained, soft, high-silicon, high-carbon iron should not contract as much as a close-grained dense iron, is not so problematical as why a thin section of iron should contract more than a thick section when the iron is of the same quality. Probably the same law is operating, and obeyed in both cases, but the understanding of that law is difficult. In the former the low specific gravity and density largely account for the difference.

The influence of high silicon upon a still higher carbon is to promote the formation of graphitic carbon, which appears in flakes, the lightest form of

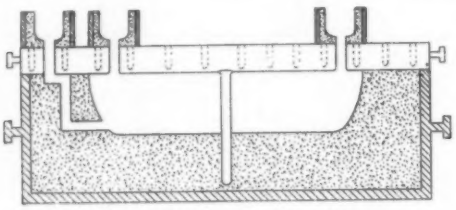


Fig. 4.

carbon, which probably affects the molecular and crystalline structure. Cleavage and crystalline structure is as yet very little understood.

The increase or decrease of contraction in thin and thick sections is usually said to be due to the percentage of combined carbon, the contraction increasing as the combined carbon increases; but that does not always follow. The influences and factors which have a tendency to increase combined carbon, such as quick and rapid cooling by chills and quenching, the effect of manganese, sulphur, and other metals and metaloids, are well known and need not be dwelt upon at present. Of course under normal conditions, a thin section of iron will cool quicker than a thick section, and usually the quicker the section cools, so will the combined carbon and contraction increase.

Fig. 1 is one of a number of castings 40 in. in diameter, 9 ft. long by 2½ in. thick, made in loam and vertically poured. The core for this casting was the same as for the other castings, *i.e.*, the core barrel was of the key-and-hinge type; when the 6-in. wide key was knocked down and the lift was on the barrel by the crane, it was pulled inwards on the hinges to the extent of about two inches on the key side, thus liberating itself from the casting. The barrel had about ¾ in. of loam on either side, no bands being used. In the instance in question the liberating key was knocked down 45 minutes after pouring, which was usual with a casting of that thickness. There appeared nothing unusual when liberating or drawing the barrel, but when the casting was stripped the following day, an irregular lump or apparent swelling was found inside the pipe at the bottom, as shown in Fig. 1. The actual size and shape is shown in Fig. 2; the weight of the piece, which is still in the writer's possession, before the edges were fractured, was about 4 lbs. The remarkable features of the occurrence are:—(*a*) That the lump should have formed when the casting had been poured 45 minutes before the key-way was knocked down; (*b*) that it could not have formed before the key was knocked down, because there was only ¾ in. of loam between the iron key and the core of the casting, the lump in its thickest part being 1¼ in., while also it was impossible for the key to have given in that particular place from pressure, for if that had happened the iron would have run out at the bottom when being poured; (*c*) that the lump was quite distinct from the casting, *i.e.*, there was a clean skin on the bore of the casting and the back of the lump. When the dresser commenced to cut it out with chisel, it fell off, leaving a perfectly clean skin on the piece and the core of the casting, absolutely no indication whatever being left upon the casting that a lump had been there, nor any sign of where the casting had bled into the loose piece.

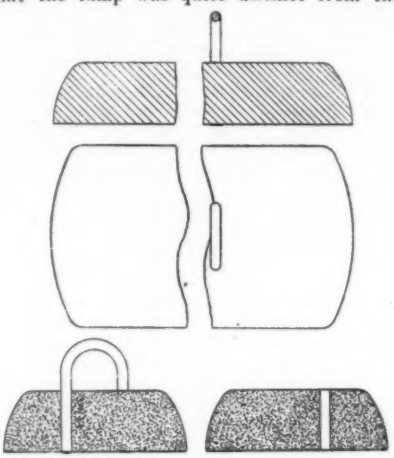


Fig. 5.

The obvious conclusions to be drawn are as follows:—The casting must have bled over 45 minutes after being cast, and near where the piece was found—probably right at the bottom where the lump was thickest and roughest. As the liberating key was being knocked down, since it could only fall a little at a time at first until down about an inch, when it would fall inwards and be free, with each knock of the hammer the iron must have bled out in a trickling way, and, taking the line of least resistance, forced its way upwards between the loam on the liberating key and the inside of the casting. When the dull liquid iron rose to the extent and width of the lump, which was about 5½ in. by 6½ in., the iron would then clog itself, being very feeble in fluidity. (See Fig. 2.) The greatest area of metal at the bottom of the casting, counting the thickness of flange, which was 3¼-in. thick, plus the 2½-in. thickness of the casting, and the 2-in. thick bracket which joins, would be nearly 4 inches. The most striking feature of the occurrence was that the loose piece shaped itself into a feather edge in all directions except the bottom, and that it partook a smooth clear skin from the interior of the semi-fluid casting.

It is not an unknown occurrence for castings when at rest, even of uniform and heavy section, to fracture several weeks after being cast, but, as a rule, the fracture can be attributed to a definite cause with some degree of certainty. It is surprising what effects apparently trifling matters have upon large bodies of cast-iron. The striking of the sun's rays on large slabs of cast iron 4 in. to 6 in. thick at a certain angle have been known to cause them to fracture.

It is not intended at the moment to enter upon the many and general causes of fracture, as that would involve the question of molecular formation in reference to granular or crystalline structure—a subject on which up to the present very little definite knowledge has been attained. But it is known that when breaking with a sledge hammer, a slab of iron, say, 4 ft. square by 4 in. thick, it is necessary to commence striking, not in the middle, but at one side, continuing the blows right across, backwards and forwards, in the same line, until the fracture commences and is completed, although the first few blows of the hammer may show no crack to the eye, yet each blow causes an internal unseen rupture. That is to say, every hard blow disorganises the structure, and makes it easier for the next blow to complete the fracture.

A simple example of how the crystaline structure of cast iron can be influenced is shown when straightening long bent plates cold, by tapping with the round end of a hand hammer in the centre of the hollow part; by so doing the ends of the plate will fall down to the level required. It is contended, and not without some evidence, that light tapping with a hand hammer over the surface, or the effect of a rumbling drum, will strengthen light castings. This is probably due to the fact that cast-iron crystals arrange themselves in a certain design, possibly cubical, and at right angles, and the tapping or rumbling disarranges or alters to some extent both the system of design and angular formation, making them closer and more irregularly intertwined, thus strengthening the structure throughout the mass.

A buoy-sinker (really an anchor for anything either on land or in water) is shown in Fig. 3. This is 4 ft. 6 in. long by 3 ft. wide, and 12 in. in the thickest part, the weight being about 50 cwts. Fig. 4 shows the way it was moulded and poured, being in a dry-sand mould. Several of these were made the same size as the one shown, besides others of larger and smaller dimensions. The casting was removed from the sand, not unduly hot, but 36 hours from the time of pouring. After it was dressed and had laid in the yard 14 days without any apparent cause it cracked, or, in foundry parlance, fled, in a line with one leg of the staple right through, the opening between the two parts being quite five inches, as shown in Fig. 5. The fractured part was perfectly sound and solid, the iron being of a medium grade, and fairly good quality. The casting had not been exposed to either heat or frost, the weather at the time had been very mild.

The problem is, regardless of what quality the iron may have been, even if we imagine it in its most unfavourable or worst form, what internal stress, power or force had been operating to part a solid, sound casting in that way? It was subject to no external provocation, not even vibration, it being quite at rest. It may be reasonably asked why it lay so long before fracturing. The occurrence is more extraordinary when it is considered what a tremendous force must have existed internally to push out in a crack five inches on the floor a large mass of iron weighing about 20 cwts., when the casting was laid on solid ground. If the iron had been white, mottled, dead-soft, or burned, we should be no nearer a clear explanation of what power was operating. The formation of the molecular or crystalline structure when cooling may have been such that one part of the casting was pulling, or in stress against the other part, until one part became overstrained and had to give way. But unequal thickness, contraction, or cooling, can hardly enter into the problem, seeing that the casting was massively uniform. There was also an entire absence of sharp corners, angles, etc., which would in any way assist such an occurrence.

The Effect of Steam Upon Magnesite Brick or Calcined Magnesite.

In a communication to the American Press, Mr. R. H. Youngman points out that the magnesite deposits of Greece and California are of the white massive character and as a rule of very pure quality. They are not as suitable for refractory purposes in metallurgical processes as the Austro-Hungarian magnesite, on account of composition and high cost of preparation. The white magnesites are used principally in caustic form as flooring cement and for the manufacture of carbonic acid gas, the carbonates as mined containing approximately 50 per cent. of CO_2, which may be driven off for this purpose at comparatively low temperature. A few refractory bricks are made from white magnesite, but difficulties of manufacture and high cost render the demand very slight.

Austro-Hungarian magnesite occurs in a crystalline formation and is grey in colour with tinges of brown. In comparison with the white magnesite it differs in composition and formation. The chemical composition is the most important difference. Comparative analyses of the two kinds of magnesite, calcined, are as follows :—

	Austro-Hungarian.	White.
Silica (SiO_2)	2.75	2.50
Alumina (Al_2O_3)	0.50	0.25
Iron oxide (Fe_2O_3)	7.00	1.00
Lime (CaO)	2.50	2.25
Magnesia (MgO)	86.50	93.00
Loss on ignition	0.75	1.00

The impurities in the Austro-Hungarian render it less refractory, and it will frit more readily at operating temperatures, which is a very important property, especially in open-hearth practice in building the bottom and repairing the slag line. In the calcined form, for commercial uses, Austro-Hungarian magnesite has a rich brown colour and white magnesite is either white or a very light brown, depending upon the thoroughness of calcination.

It is an interesting fact, and one of importance to all users of magnesite, that when subjected to the action of steam, magnesite in calcined form, or even the most thoroughly burned brick, will hydrate, similarly to the action of calcined lime when water is added. This hydration takes place to equal degree in all brands of magnesite brick. The effect of the hydration is disintegration to an almost impalpable powder. It does not seem to bear any relation to the content of lime or other impurities.

Difficulties of this nature have been experienced in open-hearth furnace bottoms by laying the brick and magnesite bottom over a bed of refractory materials mixed with water. Upon heating up steam is formed and the bottom may be very badly damaged by hydration of magnesite. This fact, which has not been well established until recently, no doubt accounts for a number of similar troubles which have occurred in years past.

British Foundrymen's Association.

Lancashire Branch.

The opening meeting of the Session of the Lancashire Branch of the British Foundrymen's Association was held on Saturday, October 17, when the new President (Mr. T. W. Markland) delivered his Presidential address. Mr. Markland said that he regarded institutions such as the British Foundrymen's Association, as powerful factors for educational work. The object of meeting together was to consider the prob'ems which were met every day in carrying on foundry operations on a commercial scale, and to learn from each other their varied experiences. Many persons prided themselves on the possession of exclusive information of such value that they could not afford to give away any of it. The man who thought he could tell everything about a subject was himself only a beginner in the study of the subject. It was on a principle of give and take they were met together, exchanging scientific and practical knowledge, and he thought no one among them was so poor as not to have some small gift to lay on the altar of knowledge. They sought to know the laws that governed all the operations of a foundry and by a knowledge of those laws produce work successfully and economically. The moulder, whatever his faults might be, had nothing to fear, as a practical man, in comparison with those of any other nation. But technical education had not usually formed part of the moulder's equipment. It was an unfortunate fact in this country that, as a body, they did not display much eagerness for educational improvement.

While the science and art section of the educational department had been of great use to many of their workmen and had enabled numbers of them to become foremen and managers, its methods of teaching could not, up to the present, be regarded as satisfactory or at all thorough, and he (the speaker) thought that the hope in the future lay in the infusion in that department of a superior class of teachers. Let them consider what were the chances of rising above mere drudgery for the youths usually desirous of learning foundry work? In most cases they were so badly equipped educationally as to be for years wholly unaware of the fact that they were ignorant of almost all things worth knowing. When they, as happened in some cases, became conscious of the existence of a higher knowledge, they were debarred by the inadequate education they had received from seeking to acquire such higher knowledge. Thus a deficient elementary education began a life of unremitting toil with no hope or expectation of any rise above the dead level of the "daily round, the common task." Many practical men had a contempt for those who had not actually worked at the trade and yet endeavoured to explain the laws and principles governing workshop practice. They had no faith in what they called book learning. He (the speaker) thought that the workmen who scorned book learning and technical education were wrong. He admitted that some foundrymen never had any technical education, and yet they were unsurpassed as skilled and successful workmen, and he accorded all praise to such. But he maintained that employers had a right to expect better results from the present-day man than from his father, because of the improved tools provided. The future foremen and managers would be men who had added scientific knowledge to practice.

Continuing, the speaker commended to young men engaged in foundry work careful consideration of present-day conditions, and asked them to resolve to rise to the height of their opportunities. He asked foundrymen to study processes bearing upon their work. Specialising in castings would necessarily be one of the features of future development. There was an increasing tendency to confine the manufacture of a particular type of casting to particular shops, properly constructed and arranged for that purpose, or to build the whole foundry for that particular type of casting. That caused an immense simplification, both with regard to cost and cheapness of production, as everything was arranged for the particular type of casting to be made at a greatly reduced labour cost. Perhaps the greatest advance made in this country with regard to ironfounding had been the increasing attention paid to the study of the metallurgy of cast iron. He could assure the members that the study was very fascinating, and there was an enormous amount of work yet to be done with regard to metallurgy generally, ferrous and non-ferrous. The chemist or the metallurgist in the foundry had not in every case been immediately productive of better results, owing to the fact that the metallurgist had first of all to study the circumstances and conditions obtaining in the works. Every foundry manager, however, ought to become a student of metallurgy in order to enable him to apply the work of the metallurgist in a systematic and practical way.

Research was open to the practical man, and even he had an interest in finding the reason why a certain result was obtained. Work alone would tell, and research was absolutely essential if facts were to be discovered; diligent work with keen observation would assist the individual, the industry and the country. There was not an establishment in this country to-day in a position to say that its knowledge of the process followed was complete. The future, therefore, lay in scientific research. The field for work was large, and it was the duty of every student to publish the results of work done or observations carefully made. It mattered not how they differed in their conclusions; they demanded respect provided that the matter submitted represented work and thought. Knowledge was never complete, and it was always well to remember that one step forward was one step gained.

One means of assisting apprentices was by the foreman speaking to them about the trade and letting them try at different classes of work done in the shop. He would like to see more sympathy from the general foundrymen to technical education. So far there seemed to be a pessimistic view taken; they seemed to think that where plate and machine work was adopted it was taking the trade out of their hands. In his opinion such a view was wrong, because cheaper production had always resulted in more trade. One change he would like to see in the foundry was this, that a moulder should be a moulder and not a sand mixer, metal caster and labourer. He thought that would be one of the means of cheaper production which the moulder would appreciate.

Respecting metallography, a study which he hoped some of the younger members of the Association

would take up, he felt there was in that direction a wide field of research which would amply repay any young man undertaking the study. He would suggest that, say, three or four young men should get together, decide upon a given line of study and research, and once a week meet together to compare results of their experience and work done. That would be one means of educating themselves, and when they had come to some definite understanding with regard to results they could bring the information to one of the open meetings so that the older members might be able to compliment or criticise as their work needed, and in that way good results would follow.

Referring to German competition, the speaker remarked that a very common phrase was "Oh, that's made in Germany"; but Englishmen must not be deceived as to the quality, for any one who was acquainted with German brass-ware and electrical machinery would recognise that some of the finest work in those lines came from Germany, whose thoroughness was shown in the extraordinary minuteness of detailed consideration which had been lavished upon the work. Of course, some people might say that could be done because labour was cheaper in Germany than here, but that was incorrect, for labour was only 5 to 7½ per cent. cheaper than it was in England.

There was another topic which he would like to raise. Among moulders generally there seemed to be a feeling against the Association, and indeed not only against the Association but against any youth who felt that he would like to obtain as much technical education as he possibly could. In some works there appeared to be a certain amount of restriction put upon a youth who desired to improve himself. One youth told him he had had trouble with a foreman, who seemed to have an impression that he was trying to do him out of his job, simply because he was anxious to obtain that knowledge which would fit him for some responsible position in the future. He left that shop and went to another, where he was again subjected to a similar kind of treatment. He (the President) wondered whether they could do anything to do away with that spirit by holding their meetings in different districts.

Mr. Simpkiss, in moving a vote of thanks to the President, said that Mr. Markland had referred to the educational side of foundry life, and if his ideas could be put into practice they would prove very beneficial indeed.

Mr. Penlington seconded the resolution. He said the President had spoken about the attitude of foundrymen towards the Association. He regretted very much that the Association, although it was in a healthy and flourishing condition, was not much larger numerically, because he was sure the time devoted by the members and the gentlemen who gave papers deserved a greater measure of support from the foundry trades generally, and more especially from the employers, than they had received in the past. Reference had been made to the subject of the sub-division of labour, and though that was not quite on the educational side of the subject, still it was a matter which, from the foundry workers's point of view, ought to be considered. The very mention of it, and the acknowledgment that such a thing was necessary, ought to show the employers that while they were carrying on an educational movement they had not lost sight of the commercial aspect. No doubt some of the young men in foundries who had acquired a technical knowledge thought they were being boycotted, and some foremen possibly thought the young men were trying to oust them from their positions. That was a condition of things they had had to contend with all along and they would have to live it down. If they could get hold of employers and foremen, as well as the young men, they would be able to teach each of them that it was a sort of mutual co-operation that the Association wanted to cultivate; that neither of them desired to get the place of the other, and that it was for the general benefit of all engaged in foundry work, and for the general uplifting of the trade as a whole.

Mr. W. H. Sherburn, in supporting the resolution, remarked that no doubt great buinesses had been built up by specialisation, not only in Germany but in America, whereas he was afraid that we in England liked to do too many things at once. If a firm found one of its competitors was doing pretty well on a certain article the directors would say, "Cannot we make that as well?" They then tried to make it, and if they saw another competitor making something else, an effort was made in that direction also. If they devoted their energies to one thing and did it well nobody would be able to touch them at it. He admitted there were a good many men in fairly responsible positions who did not favour the youth who was anxious to get on by means of technical studies. It was, therefore, for the more broad-minded men to get in touch with all classes of foundry workers in order to help those young men who desired to obtain technical instruction and to persuade the narrow-minded man to join the society so that his mind might be broadened.

Mr. Key said that, according to his own experience and that of others also who had worked with Germans, the German workman seemed to be more interested and more intelligent at his work than the average Englishman. He was not speaking with any bias, but it had been said that the German, as a rule, worked with the object of making his work as profitable as it could be made, without taking too much account of the pounds, shillings and pence; he tried, in fact, to make his day's outgoings a credit to himself. Unfortunately in this country men tried to make their work a profit to themselves, but they did not try to make it a credit to the firm. Broadly speaking, there was not the least doubt that if Englishmen were not so matter-of-fact, a little more progressive, and made themselves a little more elastic, they would progress at the same rate as the Germans did.

Mr. R. W. Kenyon remarked that in regard to the boycotting of the youth who was desirous of improving himself, he thought the matter went a great deal further than what the President had suggested. Not only did such a youth arouse the opposition of the foreman, but he had to put up with the sneers and scorn of his fellow workmen. That was the thing that had appalled him in the past. Some time ago he paid a visit to Germany, and when he returned, his views, as he expressed them, were these: "It is no wonder the Germans do go ahead. They deserve to do, because they have made such a perfect study of technical education and taken such pains to go right into the heart of everything. They teach scientifically."

Mr. H. Sherburn, dealing with the question of education, remarked that before many of the workers in the foundries could tackle such subjects as metallurgy and metallography it would be necessary to improve their elementary education very considerably. Even at the present day they found numberless young men in foundries who could not even write properly and certainly could not read.

Mr. Cordingley said he believed that good results would accrue from the provision of money by the State to enable workers to take up research work.

A New Design of Foundry Cupola.*

By G. R. Brandon.

The cupola here dealt with was designed with the special object of meeting the severest service requirements for large capacity and heats of long duration. The development has been gradual, the first cupola of this type of construction having been installed in 1908. To increase ease of handling and simplify the construction certain details have been incorporated. This design aims to avoid one of the greatest limitations for hard service in the ordinary construction, which is the location of the tuyeres all within the wind box. An additional blast box is used for each tuyere, similar to that used in Bessemer cupolas. This simplifies cupola operation greatly. The ordinary construction of wind box which extends to bottom plate also is done away with and a wind belt substituted.

Simple attachment of tap and slag spouts to the shell is also desirable in heavy-duty cupolas and a

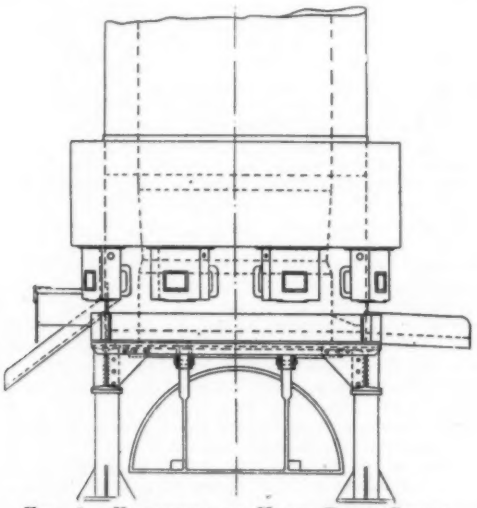


FIG. 1.—ELEVATION OF HEAVY-DUTY CUPOLA.

design for the base which would be of ample strength and at the same time of simple and reliable construction was considered advisable.

The construction may be described as follows:—The base consists of a heavy steel plate, square on the outside dimensions and with a circular opening in the middle slightly larger than the inside diameter of the lining. This plate is securely riveted to and supported by two steel H-beams at the front and rear. These beams are supported at the ends with cast-iron cylindrical columns furnished with an ample base flange to rest on concrete foundation. The top flanges of the columns are machined so as to accurately fit the flanges of the steel beam, and are bolted thereto by bolts of large diameter.

An angle bar is riveted to the unsupported edges of the bottom plate to give additional stiffness. A heavy angle makes the connection between the bottom plate and shell, and is securely riveted to both. This construction gives great strength, as the circular shell is of such a form as to give maximum strength against buckling from vertical loads or internal pressure and is comparable to a girder of the height of the stack to withstand vertical loads.

The wind box is of belt form with all joints calked air-tight. The blast entrance is the tangential type, which introduces the air into the wind box with minimum friction.

The blast boxes are of cast iron with flanges for attachment to the shell and the underside of the wind box. These joints are fitted with gaskets and are air-tight. Each blast box is provided with a peephole and cover opposite the tuyere. Also, a frame with a fusible or combustible insert is attached to the underside of each tuyere to serve as a safety device in case slag or metal overflows the tuyere. Each blast box is also furnished with a damper for regulating the amount of air passing from

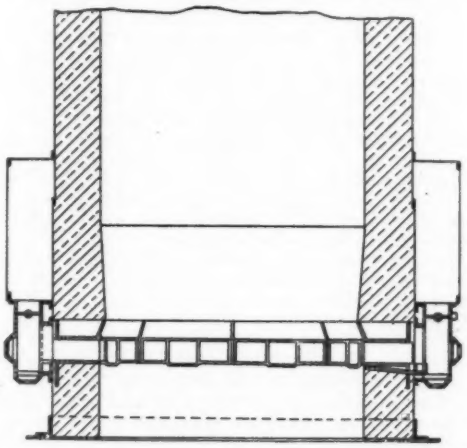


FIG. 2.—SECTIONAL ELEVATION THROUGH OPPOSITE BLAST BOXES.

the wind box to the tuyere. The tuyeres are in one row and form a continuous inlet from the shell to the inside of the lining. The tuyere castings are made in segments with a removable top all bolted together through flanges and are of rigid construction.

The top has a flange at the inner edge extending upward and inwardly and the lining is projected to come flush with inside of flange, the diameter of the lining at this point being 2 to 3 inches smaller than at the melting zone, to which point the lining is gradually sloped.

The stack for this cupola is of heavy construction, and all the joints are riveted. Supports are furnished at proper intervals for the lining and an angle is placed around the top.

Two charging doors are provided, and when desired these doors are of the lifting type, operating in vertical guides, counterweighted and fitted with an apron attached to the shell to serve in connection with a charging machine.

* Read before the American Foundrymen's Association, Chicago Convention, September, 1914.

The lining recommended consists of blocks 6 by 9 inches wide and 6 inches thick, forming an inner lining, backed by regular square and arch firebrick set edgewise against the shell. The tuyeres are of such form that it is not necessary for the bricks to fit around individual tuyeres, and the lining is easily laid at this usually-difficult point. This saves at least a day's time in relining.

Among the principal advantages of this new construction is the arrangement of the damper in each blast box, which enables the attendant to readily control lighting up and burning through the bed, which must be burnt through evenly before the last of the coke is put on and charging is commenced, to obtain the best results. Or, in case the cupola is melting badly and great oxidation is taking place at one point, which can be noted at the charging door, the individual blast gate gives the operator a means of overcoming the improper working condition. Also, by proper regulation of the dampers, unequal cutting of the lining is prevented.

The arrangement of continuous annular tuyeres in combination with liberal size peepholes permits inspection of practically the whole interior of the cupola and of reaching every part with a poke bar if necessary. The inwardly extending flange on the

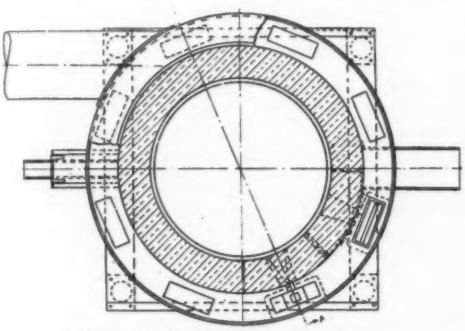


FIG. 3.—HORIZONTAL SECTION.

tuyere cover causes the molten metal and stock to descend clear of the tuyere opening, and ensures full admission of the blast. The area of the tuyere opening at the inside of the lining is very liberal.

The design of the base with the square bottom plate and columns located at the corners gives clearance for the bottom doors and for the cupola tender in cleaning out the drop and daubing up. With a steel base plate there is less danger of cracking than in the cast-iron construction, when water is thrown carelessly on the cupola after dropping the bottom.

The bottom doors have perforated cast plates with deep ribs and heavy hinge lugs, designed specially to equalise shrinkage and withstand heating and cooling. The doors are provided with pads for props and are arranged for the attachment of bottom-door hoists. The lugs for the bottom-door pins are structural steel and are bolted to the steel bottom plate.

An important feature in large cupolas is the provision for an operator's and tapper's platform of convenient height and substantial construction. This design of base readily lends itself to this construction. While some features of this design are old, it is claimed that the combination is new and affords facilities seldom brought together for convenience, safety and efficiency in cupola operation. The cupola was designed by the Whiting Foundry Equipment Company, Harvey, Ill.

"F.T.J." Bookshelf.

The Science of Works Management. By John Batey. (London: Scott, Greenwood & Son, 8, Broadway, Ludgate, E.C.)

Industrial economy and efficiency are so much under discussion at the present that considerable interest is attached to such books as this small volume, which gives a good many hints on the management of Engineering works. The author is a well-known Birmingham engineer, and he has compressed into two hundred pages much experience of works management. The volume is divided into sixteen chapters, which take up separate branches, such as the machine shop, the brass foundry, etc. The greater bulk of the volume, however, deals with organisation, and the author's remarks on this subject convey many suggestions to anybody engaged in business, whether or not he is interested in the management of an Engineering works. Mr. Batey's treatise does not, of course, deal with the details of management at the same length as do other books on the subject, such as those by Mr. Burton, and others, but in its exposition of the underlying principles of works management, Mr. Batey's volume will be found to be the equal of any yet published.

Cast Iron and Steel Pipes. By John Sharp, Wh. Sch., M.I.Mech.E. (London: Longmans, Green & Company, 39, Paternoster Row).

In presenting to his readers what he terms "Some Considerations Regarding Cast Iron and Steel Pipes," the author makes out a strong case for cast-iron as against its competitor, mild steel, both in regard to physical properties and also resistance to corrosion. The book does not deal with the production of the classes of pipes in question, but concerns itself chiefly with the theoretical considerations involved in deciding on size, thickness, etc., in relation to working conditions and pressures to be withstood. After a very brief survey of the physical and chemical properties of cast iron, wrought iron, and mild steel, the author discusses their respective transverse strengths and resistances to bursting, giving the various formulæ for calculating the same; the rules for pipes and cylinders are tabulated, and their strength under external load is discussed, some tests by the author on cast-iron pipes being detailed in connection with the latter question. A brief chapter on formulæ relating to the flow of water in pipes and cylinders is then given, followed by a consideration of corrosion, the influences affecting it, corrosive effects, means of protecting from corrosion, etc. The book in all occupies only 142 pages, but embodies a lot of useful information which engineers would do well to carefully consider before deciding the often somewhat vexed problem of steel *v.* cast iron for hydraulic work. We think that a fair consideration of the facts presented would generally decide in favour of cast iron.

General Foundry Practice. By Wm. Roxburgh. (London: Constable & Company, Limited, 10, Orange Street, Leicester Square, W.C.)

In this volume, which has previously been reviewed in our columns, a practical foundry manager deals with general ironfounding job loam practice, moulding and casting of the non-ferrous metals, practical metallurgy, and pattern-making from a moulder's point of view. The ground covered is too extensive to admit of very detailed treatment in 300 pages, but a lot of really useful practical information is embodied, particularly on the moulding side of the work. The present call in the text-book world is rather for detailed treatment of technical matters, even though it involves a book being entirely devoted to one phase or branch of a subject. But there is still a good field also for the general text-book which gives the broad lines of operation of each branch of practical work, for the beginner is always with us, and he must be catered for. In the foundry world, moreover, the rank and file workers are not, to say the least, over

provided with opportunities for education in their calling, and to these we can safely recommend Mr. Roxburgh's book. The reduction in price to 6s. for the new edition also will make the book more accessible to the readers in question.

Proceedings of the British Foundrymen's Association, 1913-14.—(Office of the Secretary, Brook House, Sheepbridge, Chesterfield.)

The 1913-14 volume of "Proceedings," as in previous years, is divided into two parts, the first part giving a full report of the Annual Conference held last May at Leicester, with the papers presented and the discussions thereon, and the second part containing a number of lectures, addresses and papers presented before Branch meetings during the session. The papers in this section are chiefly those to which prizes or diplomas have been awarded, and thus they represent valuable contributions to foundry literature. The volume should be in the hands of every foundryman interested in the progress of the craft, even though he may not be in touch with the British Foundrymen's Association itself. A complete list of members of the Association concludes the volume.

The "Mechanical World" Pocket Diary and Year Book for 1912. (Manchester: Emmott & Company, Limited, 64, King Street.)

The twenty-eighth issue of this useful Year Book contains a number of new features. The section on toothed gearing has been rewritten and extended very considerably; it now embodies a deal of practical data on the subject, and includes some useful notes on gear cutting. A new and lengthy section has been introduced dealing with structural iron and steel work. The section on the gas engine has been revised and extended, while a new section has been introduced dealing with limit gauges.

Publications, &c., Received.

The Magnet of Commerce.—Under this title the Great Central Railway's Publicity Department, 216, Marylebone Road, London, N.W., have issued a brochure of some 150 pages dealing with the coalfields of the country and their principal seams, the distribution of coal, and in particular the facilities and equipment of Immingham Docks. A map of the Company's system and a list of the collieries served by it are also included in this interesting publication.

Lawson, Walton & Company, Mosley Street, Newcastle-upon-Tyne.—To advertise their foundry and engineering supplies this firm are issuing useful little packets of court plaster in celluloid covers.

USE OF ASSUMED NAMES BY ALIENS IN GREAT BRITAIN.—A Proclamation making further restrictions on aliens in the use of assumed names has now been issued, apparently with the idea of counteracting the wholesale changing of names lately carried out by German and Austrian traders in this country. By Order in Council, the following article is inserted in the Aliens' Restriction (Consolidation) Order:—

"An alien enemy shall not, after the twelfth day of October, nineteen hundred and fourteen, for any purpose assume or use, or purport to assume or use, or continue the assumption or use of any name other than that by which he was ordinarily known at the date of the commencement of the war.

"Where an alien enemy carries on, or purports or continues to carry on, or is a member of a partnership or firm which carries on or purports or continues to carry on any trade or business under any name other than that under which the trade or business was carried on at the date of the commencement of the war, he shall, for the purposes of this Order, be deemed to be using or purporting or continuing to use a name other than that by which he was ordinarily known at the date of the commencement of the war."

Queries.

Troubles with Pipe Castings.

In making 3-in. and 1½ in. boiler tubes trouble is experienced with blowholes on the top part of the pipe. Loam cores are being used, constructed with straw bands and ½-in. of loam. Several mixtures have been tried, the present one being a little close:—No. 1 mixture: Three buckets of yellow sand and one of horse-dung. No. 2 mixture: Three buckets of yellow sand, one of horse-dung and one of sea sand. (This improved the pipes.) No. 3 mixture: Three buckets of yellow sand, one of horse-dung, one of sea sand, and half of coal dust. (This gave good results for the first cast, but the next cast was all wasters.) I have tried risers each end, some with risers on one end only, and others again without risers, and get the same results. It occurs to me that there may be something better than water with which to mix the blacking. Do you think that putting the blacking on too thick would make the castings blow?

"TUBES."

Answer.—The trouble appears to lie in the nature of the sand used, for there is every indication of that material being too close and containing too much organic matter. The fact that the introduction of sea sand somewhat improved the results confirms this. Since the nature of the sand is not stated, however, it is impossible to state exactly the cause of the trouble. We advise careful examination of the sand and a little experimenting with some other variety, bearing in mind that if the mould is so constituted that the gases, not only those from the interior of the mould, but also those which the hot metal creates from the organic matter (horse-dung included), cannot be got through the sand, evidence of the fact will be found in the castings.

Export of Supplies to Russia.

The Commercial Attaché of the Russian Embassy has made an announcement, on behalf of the Russian Commission for the purchase of supplies, informing manufacturers, merchants, and shippers executing orders for the Russian Government, that application for permission to export to Russia any articles for the use of that Government, the export of which from the United Kingdom is prohibited, should be made through the Commission, 192, Cromwell Road, London, S.W.

Before forwarding such applications to the proper authority, the Russian Commission must be satisfied that the articles to be exported have been ordered by or on behalf of the Russian Government, and exporters should accordingly ask the Russian authorities in Petrograd to confirm to the Russian Commission in London that the goods ordered are for the Russian Government, or for firms carrying out Russian Government contracts.

Manufacturers, merchants, and shippers, in asking the Russian Commission to obtain permission to export, must state:—(1) Nature and quantity of goods to be exported; (2) name and address of consignor; (3) name and address of consignee; (4) port and date of shipment; (5) ship, or line, by which shipment is to be made; (6) port of discharge; (7) marks on packages, if any.

If this information cannot be given at the time of application, it should be sent to the Commission Internationale de Ravitaillement, India House, Kingsway, London, W.C., together with a statement that a request to secure authorisation to export has already been communicated to the Russian Commission.

British Foundrymen's Association.

Branch Programme.

The following are the programmes for the 1914-15 Session of some of the Branches of the British Foundrymen's Association. The London Branch programme was published in our last issue.

Birmingham Branch.

November 28.—"Some Applications of Semi-Steel," by J. J. Howell (Birmingham).

January 23, 1915.—"Iron, Carbon and Phosphorus, in View of Modern Researches," by J. E. Stead, D.Sc., D.Met., F.R.S., F.I.C. (Middlesbrough).

February 27.—"The Use of Producer Gas in a Foundry," by T. McFarlane (Horsehay, Salop).

March 13.—"Malleable Castings," by W. H. Hatfield, D.Met. (Sheffield).

March 27. "Foundry Organisation," by A. Harley (Coventry).

April 24.—"Copper Alloys, with Notes on Brass-foundry Practice," by H. L. Reason (Birmingham).

February 13.—Meeting in Coventry; Address on "The Origin and Development of the Foundry Cupola," by R. Buchanan, F.R.S.A.

Scottish Branch.

November 7, 1914.—"Moulding and Casting of Ingot Moulds," by John Logan.

December 12.—Discussion on foundry problems.

January 16, 1915.—"Impressions on Various Types of Cupolas," by R. B. Robinson.

February 13.—"The Moulding of a Turbine Casing in Loam," by William Bell, Jun.

February 27.—Subject to be announced later.

March 27.—Annual business meeting, and discussion on foundry problems.

Newcastle-on-Tyne Branch.

November 28.—Paper by J. G. Robinson (Halifax).

January, 30, 1915.—Annual dinner.

February 27.—Open discussion.

March 27.—Paper by H. Pilkington (Chesterfield).

April 24.—Paper by H. Pemberton (Derby).

May 29.—Open discussion and annual meeting.

Owing to Armstrong College being converted into a military hospital, the meetings will be held elsewhere. Members will be duly advised.

The officers elected for this Branch are as follows:—*President*, Mr. J. W. Weir (South Shields); *Vice-Presidents*, Mr. M. E. Gallon and Mr. J. W. Paulin; *Hon Secretary*, Mr. H. A. J. Rang; *Committee*, Messrs. W. Mathews, J. D. Carmichael, J. Smith, H. C. Horsley, H. Ford, E. Smith, R. R. Denton, J. C. Collin, A. Morris, Geo. Vardy, M. B. Herbst, B. W. Johnson, J. N. Simm, R. H. Greensitt, and S. W. Wise.

Halifax and District Branch.

November 14, 1914.—"Moulding a Flywheel from Strickle Boards and Core Boxes," by J. G. Robinson (Halifax).

December 12.—"The Foundry Chemist," by A. Harrison (Manchester).

January —, 1915.—Annual dinner (date to be fixed later).

February 6.—"The Metallurgy of Iron: (1) The Constituents of Cast Iron; (2) the Constituents of Malleable Cast Iron," by Dr. W. H. Hatfield (Sheffield).

March 6.—"Copper Alloys, with Notes on Brass Founding," by H. L. Reason (Birmingham).

April 17.—"Mixtures of Iron for High-class Castings," by H. Pemberton (Derby).

The War and Neutral Countries.

Absolute and Conditional Contraband.

An important Proclamation was issued on October 29, affecting the relations of this country as a belligerent towards neutral nations. The Proclamation makes the following articles absolute contraband:—

Arms of all kinds, including arms for sporting purposes, and their distinctive component parts.

Projectiles, charges, and cartridges of all kinds, and their distinctive component parts.

Gun mountings, limber boxes, limbers, military wagons, field forges, and their distinctive component parts.

Range-finders and their distinctive componen parts.

Armour plates.

Hematite iron ore and hematite pig-iron.

Iron pyrites.

Nickel ore and nickel.

Ferro-chrome and chrome ore.

Copper, unwrought.

Lead, pig, sheet, or pipe.

Aluminium.

Ferro-silicon.

Barbed wire, and implements for fixing and cutting the same.

Warships, including boats and their distinctive component parts of such a nature that they can only be used on a vessel of war.

Aeroplanes, etc.

Motor vehicles of all kinds and their component parts.

Mineral oils and motor spirit, except lubricating oils.

Implements and apparatus designed exclusively for the manufacture of munitions of war, for the manufacture or repair of arms, or war material for use on land and sea.

The following are made conditional contraband:—

Gold and silver in coin or bullion; paper money.

Vehicles of all kinds, other than motor vehicles, available for use in war, and their component parts.

Vessels, craft, and boats of all kinds; floating docks, parts of docks, and their component parts.

Railway materials, both fixed and rolling stock, and materials for telegraphs, wireless telegraphs, and telephones.

Horseshoes and shoeing materials.

Exporting Prohibited Articles.

An important notice concerning the export of prohibited or restricted goods to prohibited countries has been issued by the secretaries to the Commissioners of Customs and Excise. The announcement is in the following terms:—

"The Privy Council are prepared to entertain applications for the issue of general licences to export prohibited goods or restricted goods to prohibited countries. Applications must be made on the prescribed form, which can be obtained from the Commissioners of Customs and Excise, Custom House, London, and must be lodged with those Commissioners for submission to the Privy Council. The application must show the article or articles for which a licence is required, the quantities which it is desired to export, and the countries of destination, and must be confined to a particular port of exportation.

Invention.

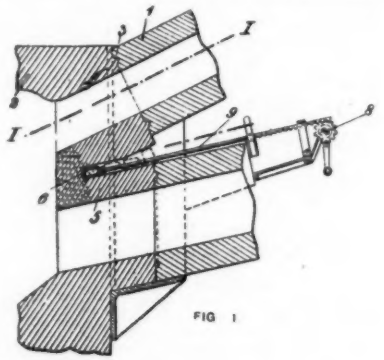
An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

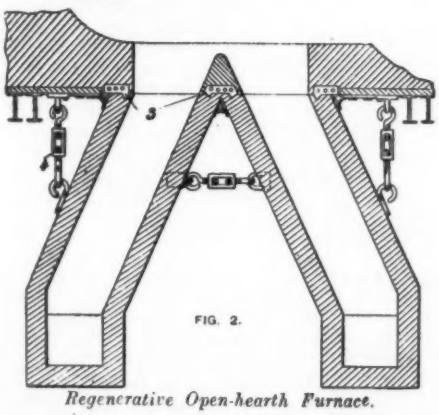
18,803. Power drilling-machines. Pneumatic Tool Company, United States.
18,826. Armour plates. C. W. Denny.
18,949. Clutch mechanism for the driving-gear of lathes, boring-machines, milling machines, etc. J. W. Barnes.
19,164.*Furnaces. American Engineering Company, United States..
19,232. Iron alloy of low hysteresis and method of producing the same. S. O. Cowper-Coles.
19,351. Gear cutting or generating machines. J. Ogden and Turbine Gears, Limited.
19,418. Regenerative furnaces. Drakes, Limited, and J. W. Drake.
19,672. Furnaces. A. Smallwood.
19,703. Grinding-machines. Boswell Hatfield & Company, Limited, and R. E. Skipwith.
19,712. Melting and casting metal. I. Hall.
19,723. Casting metals. P. D. Ionides.
20,125. Furnaces for melting brass, etc. I. Hall.
20,152. Presses for pressing scrap metal into blocks. J. Summers & Sons, Limited, and H. H. Summers.
20,232.*Air and gas heating furnaces employed in drying processes. Staveley Coal and Iron Company, Limited, and C. P. Markham.
20,304. Manufacturing pure or nearly pure metallic tungsten powder. W. B. Ballantine.
20,387. Sand-moulding. G. Moore and F. H. Griffiths.
20,582. Manufacture of steel by the basic open-hearth process. A. E. Davies.
20,736. Cupola furnaces. G C. A. Wilkins.
20,929. Furnaces. R. F. Hislop and G. R. Hislop.
20,935. Recovering and utilizing the iron in blast-furnace flue dust. J. H. Dent.
20,956. Heating and hardening apparatus. J. W. Moore and H. L. Down

Abstract of British Patent Specification recently Accepted.

23,719 (1913). *Casting Ingots of Metals and Alloys.* P. H. G. Durville, 43, rue de Berlin, Paris, France.—The process according to the invention differs fundamentally from known processes, inasmuch as the metallic liquid is first introduced into a reservoir or pocket and is then transferred from the reservoir into the mould without any change of altitude. The surface of the metallic liquid in the reservoir and in the mould remains horizontal and continuous throughout, and there is no real pouring of the liquid mass of metal, but only a change in the position assumed by the metallic liquid, without any change of direction on the part of the metallic surface. By means of this method, the casting process can go on very quickly, and nevertheless—since there is no fall, and the surface of the liquid remains in the same position throughout—no intermingling of the metallic liquid with slag or other oxidising particles, or with air, occurs, especially since the liquid is protected therefrom by the layer of oxide remaining throughout in a horizontal position on the surface of the liquid. The apparatus for carrying out the process consists of a combined reservoir and mould, the two being rigidly attached together in such a way that the pouring-out surface of the reservoir and the pouring-in surface of the mould lie in the same straight line, the connecting passage between the reservoir and mould being of uniform sectional area, that is, the sectional area of the mouth of the reservoir corresponds to the internal diameter of the mould.

17,131 (1912). *Regenerative Open-Hearth Furnaces.* H. Rehmann, Rathausufer 22, Düsseldorf, Germany. Fig. 1 is a vertical section of the joint between the furnace and the air and gas ports; Fig. 2 is a horizontal section on line I—I of Fig. 1. From the various views it will be clear that a safe and durable joint is provided between the ports 1 and furnace 2 by a groove and tongue assemblage 3 for the butting surfaces or facings of these parts. It is advantageous to coat the parts 3 with fire clay and draw same strongly together by suitable tightening devices such as 4, Fig. 2. With this joint no air can pass through and consequently no back-firing can take place so that undue burning away of the brickwork is avoided. However, it is not altogether possible to permanently prevent the burning away of the brickwork, especially the parts situated at or about the joint between furnace and the mouth of the air ports. If, as shown in Fig. 1, the insertion 6 of the comparatively quickly destroyed





Regenerative Open-hearth Furnace.

tongue 5 be shiftably mounted, it will be possible, after knocking down the brickwork, indicated by dotted shading lines, to withdraw such insertion at once from the direct action of the fire without necessitating a long interruption of the service, and then again protect the insertion 6 by filling its previously occupied space up with refractory material. The shifting of the insertion is advantageously effected with the aid of suitable gear, such as 8, which is connected with the insertion 6 through the intervention of rods or spindles 9. The insertion 6, which supports the tongue 5, can be made in the form of a cooling box (Fig. 1) or it may be a solid beam while in both cases it serves to push the newly applied refractory material against the fire-damaged tongue-portions by operating the gear 8 and 9. During the service, the insertion 6 can be repeatedly shifted so long as the prevailing conditions will permit.

15,252 (1912). *Liquid Fuel Furnaces for Melting Metals and their Alloys.* A. Etienne, L. Caust, L. Mercier, and H. Mercier, Montdidier Steel Works, 44, Route de Rouen, Montdidier, Province of Somme, France. —Fig. 1 is a vertical diagrammatic section of the furnace; Figs. 2 and 3 are a section and front elevation to a larger scale of a gasifier, and an arrangement for de-

livery of combustible liquid. The combustible liquid is placed in steel pans A, shown in detail in Figs. 2 and 3, which vary with the combustible employed, that is to say, the pans may be larger or smaller, deeper or shallower according as to whether the liquid combustible is a heavy or a light oil. These pans are placed one on each side of the furnace in a space B of refractory brick, which spaces are provided at their rear ends with an air admission door or valve, which consists of a metal plate *a* perforated to form ports *b*, which can be closed by a sliding plate *c* movable in front of *a* and having the same arrangement of ports. The liquid is fed by a pipe system C above the exterior part of the pan A, and flows in a thin stream through a cock *d* into the exterior part or rear of the pan, which is outside of the space in the brickwork B. The combustible liquid is heated owing to the conductivity of the pan, then it passes into the part of the pan inside the space in the brickwork, and is ignited by the contact therewith of air which passes either through the ports *b*, or between the upper surface of the liquid and the lower edge of the plate *a*. The first stage of the combustion is now accomplished, and the gas which issues forth distributes

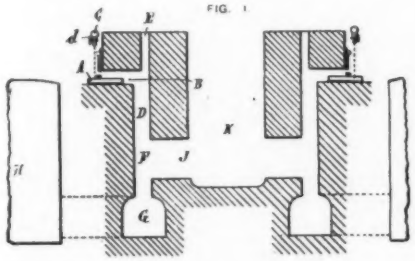


FIG. 1.

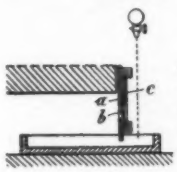


FIG. 2.

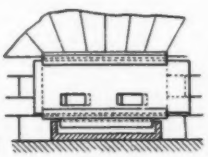


FIG. 3.

Liquid Fuel Furnace for Melting Metals and their Alloys.

itself in the vertically descending channels D. Above these channels openings E are situated for inspection and cleaning, and these permit of ascertaining the degree of combustion of the gas. During normal working the openings E are closed. The combustible products generated in the first phase of the combustion descend at F, where they encounter heated air coming from the flue G of a regenerative chamber H situated on the same side of the furnace as the passage F. The combustion thereupon becomes more active, and produces more and more heat; extending from the point F, at which place the first contact of the gas and air took place, to the entrance to the furnace at J, where the combustion becomes complete. This is the second state of the combustion, namely, the high temperature combustion effected in the burners T J. The spent gases pass by way of the other flue G, and serve to heat the regenerative chamber on the opposite side of the furnace. The draught of the chimney is controlled by means of a damper situated in the exit flue communicating with the regenerator. The control of the first phase of the combustion in the pans is accomplished by the plates *a* controlling the admission of cold air from outside and by the cocks *d* controlling the combustible liquid.

18,494 (1913). *Manufacture of Mill Rolls.* E. L. Davies, Tregenna, Vardre Road, Clydach S.O.; and W. Gilbertson & Company, Limited, Pontardawe Steel, Tinplate and Galvanising Works, Swansea.—This invention relates to cast-iron rolls in which the cast-iron body is reinforced by means of rods or bars embedded in the body, so as to enable the latter to resist tensile stresses more effectively than is possible with rolls having a body entirely of cast-iron, even although such rolls should have a central core of wrought iron or mild steel. The reinforcing element is incorporated in the body of the roll in such a manner that the cast metal constituting the body forms a homogeneous union or weld with the reinforcing element or structure. With this object, prior to the rods or other reinforcement being inserted in the mould for the casting operation, they are cleansed from oxide of iron by pickling in a suitable flux, *e.g.*, one composed of sand or silica, soda or carbonate of sodium, and borax, which is heated to a temperature sufficiently high for the purpose. Upon the rods being withdrawn from the bath of flux and allowed to cool, a protective skin of flux is formed on the surface of the rods which prevents any oxidation of the same, so that when they are placed in the mould and the cast metal teemed into the same, the flux is melted before the metal finally congeals, and a homogeneous union takes place between the rods and the metal forming the body of the roll. To attain this result it is necessary that the cross sectional area of the rods must not be so great that final congelation of the cast metal occurs before the skin of flux is melted and removed.

1,652 (1914). *Ball Bearings for the Spindles of Grinding Machines.* The Auto Machinery Company, Limited, and H. S. Wood, Hood Street, Coventry.—The claims of the patentees are as follows:—(1) The combination of a spindle having inner bearing rings pressed thereon, or races formed integral with the spindle, a housing, fixed or adjustable shoulders within the housing, outer bearing rings located against such shoulders, locking nuts screwing into the housing for pressing the outer bearings against the shoulders, and means for positively locking the nuts so that no re-adjustment of the bearing can be made without destroying the locking means. (2) A distance piece in the housing, the ends of which act as the shoulders. (3) The distance piece is made in two parts which rotate together, but are capable of sliding endwise with relation to each other, one of the parts having a screw thread on its exterior and screwing into the housing, the other part having a flange fitting against a shoulder in the housing.

Application for the Suspension of German Patents.

Several further applications with reference to patents held by alien enemies in Great Britain have lately come before Mr. T. Franks, Comptroller of Patents, and Sir Cornelius Dalton, ex-Comptroller, sitting at the Patent Office in London.

Ashton, Frost and Company, Limited, of the Bank Top Foundry, Foundry Street, Blackburn, made an application for a licence to manufacture a rotary filter for separating mechanical admixtures from liquids. Representing the applicants, Mr. O'Brien said the filter was largely used in Lancashire, and Messrs. Ashton, Frost and Company had been asked if they could supply the machine now that it could not be obtained from abroad. The patent related not only to the filter, but also to a particular process of filtering, and it had only one more year to run. Mr. Clement Lean (British agent for the patentee) said he did not wish to oppose the application, but he thought a royalty of, say, 15 per cent. on the selling price of the machine should be paid. Mr. T. A. Ashton, a director of the applicant company, gave evidence that the machine could be sold at prices ranging from £360 to £400, and the company would be prepared to pay a royalty of 2½ per cent. after 10 machines had been made. The Comptroller-General said the Court would make its recommendation in the usual way.

Trade Talk.

MICKLEWRIGHT, LIMITED, have moved to Alperton, Wembley, Middlesex.

LOXLEY & COMPANY, LIMITED, engineers, of Leeds, have removed to 35, Kirkgate, Bradford.

LAING, WHARTON, LIMITED, have removed to Mildmay Park Works, Mildmay Avenue, London, N.

SLIGHT damage has been done by a fire at the works of Edgar Allen and Company, Limited, Tinsley, Sheffield.

MR. G. LAIDLER, metal broker, etc., lately carrying on business at the Warehouse, Custom House Quay, Sunderland, has been adjudged bankrupt.

PALMERS SHIPBUILDING AND IRON COMPANY, LIMITED, have now blown in three blast furnaces, which have been out of blast since the commencement of the war.

ALLEN BARTON & COMPANY, LIMITED, of Adlington, have removed their businses to the Providence Foundry and Engine Works, St. Helens Junction, Lancs.

THE furnaces of the Langloan Iron and Chemical Company, Limited, which have been out of blast since December last, have again been put into operation.

MR. W. AIERY, engineer, carrying on business under the style of Wm. Aiery and Company, engineers, Derri View, Frogmore Street, Abergavenny, Mon., has been adjudicated bankrupt.

JOHN SMITH & COMPANY (DERBY), LIMITED, engineers, etc., Cotton Lane, Derby, and Union Street, Burton-on-Trent, have established a branch in Horninglow Street, Burton-on-Trent.

THE works of Bodill, Parker & Company, Limited, brassfounders, Great Hampton Row, Birmingham, have been very seriously damaged by fire. The roof of the works fell in, and most of the walls collapsed.

MESSRS. WRIGHT, ANDERSON & COMPANY, LIMITED, Abbot Street, Gateshead, are building works and offices at Gateshead. The site was formerly occupied by the Hill Top Works, but has lain derelict for many years.

AN interesting paper has been read by Mr. H. Brearley, before the members of the Manchester Association of Engineers, on "The Heat Treatment of Structural Steel as applied to Mechanical Engineering."

MESSRS. SCHAFFER & BUDENBERG, LIMITED, inform us that their entire Manchester business is now being transferred to their new works at Broadheath, near Manchester, to which all communications should be directed.

MESSRS. HAGGETT, YOUNG & COMPANY, 296-300, City Road, London, E.C., have acquired the business of the Messer Engineering Company, manufacturers of welding appliances, of 296-300, City Road, London, E.C.

THE Electricity Committee of Barrow have entered into an agreement increasing the amount of electricity to be supplied to Vickers, Limited, from 1,040,000 units to 5,000,000 units per annum for a period of three years.

THE council of the Liverpool Engineering Society have decided to abandon the annual dinner of the society, and a like decision has been arrived at by the executive committee of the Marine Engineers and Naval Architects.

MESSRS. ROBERT L. PRIESTLEY & COMPANY, engineers, ironfounders, etc., Canal Basin, Gravesend, have been added to the Admiralty list for the manufacture and supply of mooring and mark buoys, wrought-iron and steel plate work, etc.

THE partnership heretofore subsisting between Messrs. T. B. Rogerson, I. Urwin, and W. Cracknell, carrying on business as iron and steel founders, at Tow Law, Durham, under the style of Bond Rogerson and Company, has been dissolved.

MR. J. E. STEAD, who has been elected president of the Middlesbrough High School Engineering Society, delivered his inaugural address to the members on October 16, taking for his subject, the "Heat Treatment of Steel and the Equilibrium Diagram."

GALLOWAYS, LIMITED, of Manchester, are now making boilers of the Stirling type, *i.e.*, five-drum water-tube boilers. The company were amongst the first makers of water-tube boilers, so that the present design is the outcome of a very lengthy experience.

WILSONS, PEASE & COMPANY, LIMITED, of the Tees Ironworks, Middlesbrough, have lately put a furnace on to hematite in place of the one taken off Cleveland iron. We understand that the company have now only one furnace making the "G.W.L." brand of Cleveland No. 3 pig-iron.

A DEPUTATION representing the Birmingham Chamber of Commerce waited last month upon the Assessment Committee, and urged them to make use of the very wide discretion they possessed in order to provide that premises containing machinery should not be unduly taxed.

THE shareholders of Riley's Foundry Company, Limited, have decided that the company be wound up voluntarily, in order that it may be incorporated with and merged in J. H. Riley and Company, Limited. Mr. J. H. Higham, 44, James Street, Bury, has been appointed liquidator.

WORKMAN, CLARK & COMPANY, LIMITED, of Belfast, and Alex. Stephen & Sons, Limited, Linthouse, Govan, Glasgow, are reported to have each secured an order from the Shaw, Savill & Albion Company for the construction of a large passenger and cargo steamer for the Australian trade.

THE contract for the construction of the railway tunnel from Paddington to the Eastern District Office, authorised by the Post Office (London) Railway Act, 1913, for the conveyance of mails, has been placed with J. Mowlem and Company, Limited, Grosvenor Wharf, Westminster, London, S.W.

THE partnership heretofore subsisting between Messrs. G. F. Smart and G. B. Clark, carrying on business as engineers, at Clifden Works, 6a, Clifden Road, Clapton, London, under the style of Smart and Clark, has been dissolved. The business will be continued by Mr. G. B. Clark, under the same style.

THE CAMBRIDGE SCIENTIFIC INSTRUMENT COMPANY, LIMITED, of Cambridge, have taken over the business connection of the Leskole Company, Limited, Palace Works, Enfield, who have gone into liquidation. Mr. F. Wakeham, the assistant manager of the Leskole Company, has joined the company's staff.

HASLAM & SCHONTHEIL, LIMITED, electrical and mechanical engineers and merchants, of Cardiff, inform us that the style of the company has been altered to Haslam & Stretton, Limited, owing to Mr. Theodore Schontheil, who is a British-born subject, having adopted the surname of Stretton.

MESSRS. MACKEY & COMPANY, Orchard Street, Newcastle-on-Tyne, have acquired the site of the old boiler shops at Parks Works, Gateshead, where they are laying down shops for the manufacture of pumps and pumping machinery and to which the Orchard Street works will eventually be transferred.

THE offices of the Harland Engineering Company have been removed from 196, Deansgate, Manchester, to Greengate, Salford, Manchester, where temporary accommodation has been found for the staff in the warehouses at the rear of the new office building which is now nearing completion.

ON October 12, the opening meeting of the members of the Bradford Engineering Society was held at the Technical College, when a tour round the works in Sheffield of William Jessop & Sons, Limited, was explained in a paper by Mr. W. H. Thomas. Mr. Robert Hiles, the president of the society, was in the chair.

THE BRITISH FIRE PREVENTION COMMITTEE, of 8, Waterloo Place, Pall Mall, London, S.W., announce that a certain number of reserve firemen are available from the committee's special fire service force, to do either part time or full time watch or patrol service on factories and works engaged upon Government emergency orders.

THE directors of the Barrow Hematite Steel Company, Limited, have found it necessary to stop making allowances to any more of their workmen who join the colours. The company is largely engaged in manufacturing for war purposes, and it is becoming increasingly

difficult to carry on business owing to the shortage of labour.

At a meeting on October 19, of the members of the Sheffield Society of Engineers and Metallurgists, held in the Mappin Hall of the Applied Science Department of Sheffield University, Professor C. A. Edwards lectured on "Metallic Crystals and Some of the Changes which they Undergo with Varying Treatment." Dr. Ripper presided.

The Council of the Sheffield University have approved the formation of a Scientific Advisory Committee, consisting of the members of the Science and Applied Science Faculties and of the Department of Economics, in the hope that such a committee will be able to render service to manufacturers in dealing with the new conditions presented to them.

Mr. F. Bailey, the president of the Association of Engineers-in-Charge, delivered his inaugural address to the members of the Association at a meeting held at the St. Bride's Institute, London, E.C. The address largely dealt with the development of trade made possible by the present war, and the heavy expenditure now necessary on armaments, etc.

At a recent meeting of the shareholders of the Rowditch Foundry Company, Limited, a resolution was passed to the effect that the company could not, by reason of its liabilities, continue its business, and accordingly that the company be wound up voluntarily. Mr. W. A. Raybould, Theatre Chambers, Babington Lane, Derby, was appointed liquidator.

On October 10 Mr. E. Hillier delivered his presidential address to the members of the Manchester Association of Engineers, taking for his subject the relation of the engineer to the war. The Constantine gold medal for the best paper was awarded to Mr. Hillier for a paper that he read on power production in this country to the Association in January.

Lord Lytton has made an interesting offer to those manufacturers desirous of promoting industries in this country for the production of articles hitherto imported from Germany. His lordship is willing to provide free sites for workshops for this purpose at the Garden Village that is in process of formation on estates at Knebworth, Herts., 25 miles from London.

The export Licence Department of the Privy Council Office has been transferred from Whitehall to King's House, Kingsway, W.C., and all communications intended for that Department should be sent to the Chief Clerk. All applications for export licences, whether special or general, should, as heretofore, be addressed to the Commissioners of Customs and Excise, Lower Thames Street, E.C.

The Board of Trade, replying to the Liverpool Chamber of Commerce regarding the suggested court of abitration on matters arising out of contracts made before the war, state that, in view of the great and apparent insuperable difficulties of statutory intervention, every court should be encouraged to dispose of outstanding questions by arrangement. The Board offer their services for amicable settlement.

Mr. W. Benson, a director of Adams & Benson, Limited, iron and metal merchants, of Oldbury Road, Albion, West Bromwich, has severed his official connection with the Company, having had to remove to Devonshire. He has, however, established himself in business at Exmouth as an iron and steel merchant, etc., with the temporary address of 71, Exeter Road, until the necessary warehouse accommodation can be provided.

The Premier Cooler and Engineering Company, Limited, Broadway Court, Broadway, Westminster, London, S.W., have purchased from Balcke & Company, Limited, their London works, and have obtained an exclusive licence to manufacture their well-known cooling towers, air filters, and oil separators. The Company have also secured the services of Messrs. Balcke's technical staff, which has been engaged in the manufacture of these specialities.

The Principal of the Municipal School of Technology, Manchester, possesses particulars of more than 550 students who were in attendance at the college during the academic year 1913-14, and who are now serving in various branches of His Majesty's Forces. With a view to the completion of a Roll of Honour, which shall also include the names of past students engaged upon military service, the Registrar will be glad to receive any information regarding such persons.

Mr. David Cameron has resigned his position as London representative to the Lanarkshire Steel Company, Limited, Motherwell, as from December 31, 1914, and is commencing business on his own account under the style of Messrs. David Cameron & Company, iron and steel merchants and agents, 134, Fenchurch Street, London, E.C. The new firm has secured the London agency for Wright, Anderson & Company, Limited, structural engineers, Gateshead-on-Tyne.

John Wood & Sons, Limited, of Wigan, are extending the erecting shop and building a new dressing shop at their Frog Lane Works, where amongst other orders nearing completion they have a steam driven set of three-throw pumps for a Russian colliery, two pairs of large winding engines and a set of hauling engines for an Indian colliery and a pair of winding engines for a South Wales colliery. These last are fitted with two drums, and designed to wind from two levels.

Moses Eadon & Sons, Limited, of the President Steelworks, Sheffield, are placing on the market a combination file patented by Mr. J. H. Barker, who has had charge of their works for many years. The file is a combination of an ordinary standard file and a milling file, and has a series of original grooves. The makers claim that it saves 30 to 50 per cent. in wages, does not clog, leaves a smooth surface, removes more material, and lasts longer than an ordinary file.

The Cambria Steel Company are proposing to open an office in London. They are removing their sales office from Johnstown, Pa., U.S.A., to Philadelphia, where the executive offices of the company are situated. We understand that sales offices in Rio Janeiro, Mexico City and Buenos Aires, are also to be established with the idea, no doubt, of vigorously pursuing the policy recently inaugurated in the United States for the extension of the foreign trade of the country.

The Selson Engineering Company, Limited, of 83-85, Queen Victoria Street, and Lambeth Hill, London, E.C., desire to contradict the rumour that their company is a German concern. The company was registered in December, 1909, under the Companies (Consolidation) Act, 1908, and is a strictly British concern, both as regards capital and directorship. They manufacture in this country, having works at Coventry and Halifax, whilst the staff and workmen, with only two exceptions, are British.

Sophus Berendsen (London), Limited, engineers and contractors, have removed from 155, Fenchurch Street, London, E.C., to larger and more commodious premises in Windsor House, Kingsway, W.C. The company represent in this country La Société Anonyme des Hauts-Fourneaux and Fonderies de Pont-à-Mousson, manufacturers of cast-iron pipes, who have, we understand, opened a temporary office in this country at Messrs. Berendsen's offices, in consequence of the disruption of business caused by the war.

Considerable progress has been made with the construction of the new works of Sir W. G. Armstrong, Whitworth & Company, Limited, at Longueul, Canada. It is understood that the construction of warships will not be undertaken, but that the works will be confined to the manufacture of forgings, shipbuilding sections, castings, shaftings, etc. A tax exemption for 20 years has been granted to the company, and it is anticipated that when in full operation the establishment will find employment for upwards of 4,000 hands.

Redpath, Brown & Company, Limited, are extending the constructional department of their works at Trafford Park, Manchester, by the erection of a bay, 300 ft. by 80 ft. This extension is at right angles to the existing shopping, which is covered by two similar bays. When the new building is completed the whole works will be entirely remodelled, so that the material will be delivered at the far end of the new shop, around which there are also extensive stock grounds, and pass through the works to the loading siding.

Hans Renold, Limited, are making important extensions to their Burnage Works, to a portion of which the

plant from the Brook Street Works, Manchester, has already been transferred, and those works have been shut down. The head office will also shortly be transferred to Burnage, where temporary accommodation will be found for the staff, pending the erection of the projected new offices adjoining the works. The new works will enable the company to carry a very much larger stock and render the same more easily available.

MEMBERS of Messrs. Cammell, Laird & Company's Grimesthorpe Steel Works Ambulance Class received their certificates and other awards on October 9. Mr. J. Little, general manager of the Grimesthorpe Works, who presided and made the presentations, expressed pleasure at the splendid results which had been achieved in the examination recently held. He felt that ambulance work was greatly helpful not only to the works, but also to the men themselves. He hoped that every man would work hard so as to pass the higher examination next year. He considered that 66 passes out of 75 entries was excellent.

A COMPULSORY winding-up order was made on October 13 by Mr. Justice Neville against Tannett, Walker & Company, Limited, of Leeds. According to the statement made by counsel, the company had a large first mortgage debenture issue, and in the prospectus it was stated that the assets were valued at £329,000. There was a further issue of stock to the amount of £50,000. In addition to the mortgage stock, the company created debentures, giving specific charges on machinery and running contracts, some of which were outstanding when the receiver was appointed. So far as could be ascertained the assets would realise about £25,000.

IN his quarterly report to the Middlesbrough Chamber of Commerce, the secretary states that exact statistics relative to the make of pig-iron at the furnaces within the port of Middlesbrough during the three months ended September 30, 1914, are not obtainable. The following, however, are the estimated figures for this period, together with those for the previous quarter and the corresponding period of 1913 :—

	Cleveland pig-iron Tons.	Hematite, spiegel, basic, etc. Tons.	Total. Tons.
Quarter ended Sept. 30, 1914	300,000	272,000	572,000
Quarter ended June 30, 1914	355,000	240,000	595,000
Quarter ended Sept. 30, 1913	407,000	260,000	667,000

MESSRS. E. G. APPLEBY & COMPANY, of London, engineers and contractors for structural steel work, gas producers and other steel works plant, inform us that the Kerpely revolving-grate gas producer is and has always been manufactured in this country to their own patterns and drawings, they having acquired the patents outright, so that no question of trading with the enemy or payment of royalties to foreigners need be considered in placing contracts for Kerpely gas plants. Other specialities Messrs. E. G. Appleby & Company are selling, all of British manufacture, include the Phoenix electro magnet, of which the patentees and manufacturers are Messrs. Steel, Peech & Tozer, Limited, of Sheffield.

To enable those who may have been prevented from taking their usual holidays, the Great Central Company are continuing the issue of cheap tickets every Saturday during November from Marylebone to the popular holiday resorts on the North-East and North-West Coasts, as well as to the numerous inland towns and health resorts served by this railway. The tickets are available by express trains, which, with a few exceptions, are equipped with restaurant cars, which provide à la carte meals to suit the convenience of the passenger. Particulars of fares, trains, etc., can be obtained at Marylebone Station and agencies, or on receipt of a postcard addressed to Publicity Office, 216, Marylebone Road, London, N.W.

AT the monthly meeting of the Employers' Parliamentary Association, held in Manchester, the President, Sir Charles W. Macara, Bart., in the chair, the following resolution was carried unanimously :—"That the various interests—industrial, commercial, financial, transport and labour—ought to co-operate with the Government in order to keep the industries of the country going as far as it is possible to do." As regards our trade relationships with enemy countries, the following resolution was also unanimously adopted :—"That this Committee strongly supports the opinion of the Association of Chambers of Commerce that the Government be urged to enter into negotiations with the Committee of Bankers with a view to the assets of manufacturers and merchants in the way of foreign book debts and stock being guaranteed against loss jointly by the Government and the banks."

AT the London Bankruptcy Buildings, meetings have been held of the creditors and shareholders of the Consolidated Diesel Engine Manufacturers, Limited, of London and Ipswich. The accounts filed showed liabilities £72,492, of which £43,322 is unsecured and assets £285,401, showing a surplus of £240,073. The contributors' deficiency is returned at £350,879. The failure of the Company was attributed to insufficiency of working capital, excessive expenditure, and the locking up of the Company's money, through making advances to the old Company. It was also due to the Company's inability to raise money on the shares in Carel Freres, to whom a sum of £40,000 had been advanced. The Assistant Official Receiver remarked that negotiations for bringing in fresh capital and placing the concern on a new footing had completely broken down. Resolutions were passed for the appointment, as liquidator, of Sir William Peat, with a committee of inspection.

SOME interesting references to the future of the iron and steel industries were made by Mr. H. Beard, the recently elected president of the West of Scotland Iron and Steel Institute, in his presidential address to the members on October 16. The future of the trade in this country, he said, would depend entirely on the course of events in connection with the war. He thought it would be well for them to bring their works to a state that would allow the manufacture at home of all the supplies of iron and steel previously obtained from abroad. That would allow them to manufacture a larger share of the supplies required by our Colonies, and would enable them to capture a share of the trade in Latin America and in Asia. Referring to the iron and steel works of Belgium, Mr. Beard said that whenever the opportunity occurred this country was bound to assist a country that prior to the war exported 80 per cent. of its finished products, of which our Empire took so large a share, and with so great an advantage to our home and Colonial consumers.

IN addition to the awards announced in April for papers read at the meetings, the Council of the Institution of Civil Engineers have made the following awards for papers published in the Proceedings without discussion during the session 1913-1914 :—A Telford gold medal to Mr. J. V. Davies (New York); Telford premiums to Messrs. W. C. Popplewell (Manchester), A. J. Knowles (Cairo), H. Gaskell, jun. (Widnes), P. Rothera (Trichinopoly); the Crampton prize to Mr. H. F. Carew-Gibson (London), and the Manby premium to Mr. W. M. Griffith (Bareilly, India). The Webb prize for the best paper on railway machinery published during the past three years has been awarded to Mr. Henry Fowler (Derby); and the Indian premium for 1914 to Mr. P. Rothera (Trichinopoly). The council have made the following awards in respect of students' papers read during the session 1913-1914 :—The "James Forrest" medal and a Miller prize to Mr. J. E. Swindlehurst (Birmingham); and Miller prizes to Messrs. T. C. Grisenthwaite (Glasgow), H. J. C. Harper (Bristol), W. P. Nevett (Birmingham), J. M. L. Bogle (Manchester), E. A. Cross (Birmingham), S. Brassey-Edwards (Manchester), G. T. Cotterell (Bristol), D. D. Stanier (Newcastle), W. E. Curry (London), H. Taylor (Birmingham), and R. C. Rattray (Manchester).

NOTICE is given that, at the expiration of three months, the names of the undermentioned companies will, unless cause is shown to the contrary, be struck

off the Register of Joint Stock Companies, and the companies will be dissolved:—Automatic Lock Nut Company, Limited; Dominion Engineering Company, Limited; Kilby Engine and Motor Syndicate, Limited; Lewis Engineering Company, Limited; London Steel and Oil Furnace Company, Limited; Machinery, Limited; Metal Finishers (1910), Limited; Pensher Foundry Company, Limited; Power Engineers, Limited; and Salamander Fire Bar and Smoke Preventer Company, Limited; Austin Letter Foundry, Limited; Automatic Weldless Chain Company, Limited; British Metallic Roofing and Construction Company, Limited; Central Foundry Company, Limited; Chili Copper Sulphate Syndicate, Limited; Economic Furnaces, Limited; Empire Acetylene Gas Apparatus Syndicate, Limited; Graham Robinson Steel Company, Limited; Hawksley, Wild and Company, Limited; Metals Finance, Limited; Parker Machine Tool Company, Limited; Smethurst Furnace and Ore Treatment Syndicate, Limited; Stockport Engineering Company, Limited; Sutcliffe Machine Company (Midlands), Limited; and the Wolfram (Tungsten) Syndicate, Limited.

A VERDICT of "accidental death" was returned at the inquiry into the circumstances of the deaths of the two men who were injured by an explosion at the steelworks of Alfred Hickman, Limited. E. Davies, foreman, said the furnace at which the explosion occurred had been off for repairs. On the Saturday morning witness ascertained that it had been put in order again, and was ready for the reception of gas. Prior to gas being admitted to the furnace the water seal had to be attended to. In the opinion of witness there must have been a slight leakage unknown to anyone, and, as a consequence, there was an explosion, and doors provided in the nature of safety outlets flew open. It was not an uncommon thing to have an explosion of the kind; but in this instance witness was under the impression that the deceased men were doing something to the doors, and when they flew open they were struck and flung away. As a matter of fact, they experienced the full force of the explosion, and were badly injured. Replying to a question, witness said the only solution he could arrive at was that probably a little hard tar had prevented the valve working properly. The company's advocate stated that steps had been taken to design a water-seal valve which would obviate the chance of a similar accident occurring in the future. The valve in use was the type of those used in all steelworks in the country.

THE 1914-15 session of the Sheffield Branch of the British Foundrymen's Association was inaugurated on October 23, by a smoking concert held at the Grand Hotel, Sheffield. Mr. T. H. Firth (president), who occupied the chair, in his opening remarks, expressed a hope that the meetings of the Branch during the coming session would be well attended. Excellent papers, some of which were very practical ones, had been arranged, and he was sure that if they could only meet each other and have chats after the papers some good would come of it. Remarking on the war, he said it had come just at the right time, and he honed that after it was over we should be able to show Germany that there was still something left in Britain, and that we were not going to be outclassed, either in war or commercially. The foundry would have difficulties to face. People would bring drawings or patterns, and would say: "This came from Germany: can you make it?" Sometimes, in the past, when the foundryman had been fairly busy, he had said "We can do without that; let somebody else have it." He hoped they would not adopt that attitude after the war, but would see if they could not by some means make the casting or whatever it was, and so compete and get back a lot of the work which Germany had for years been doing for our colonies and other countries. Following the chairman's introduction, a capital programme was proceeded with, songs being given by Messrs A. Dakin, E. Sheridan, Harry Heath, J. Currie, and W. Poulton, and humorous monologues by Mr. W Thompson. Mr. Rodgers was the accompanist. During the evening a collection was taken for the purpose of sending cigarettes to the soldiers at the front, and £6 2s. was raised. The ensuing session promises to be an interesting one. The meetings will begin this month, and papers will be given by Mr. Cook, Dr. Rosenhain, Mr. C. A. Edwards (Manchester), Mr. F. Darley, Dr. Ripper (Sheffield University), and Mr. Victor Stobie.

Legal.

Assets of Alien Enemies.

The action of J. Wild & Company, Limited, of Middlesbrough, versus Fried. Krupp Actien Gesellschaft, has been mentioned before Mr. Justice Sankey in the Vacation Court. Mr. Terrell, for the plaintiffs, explained that they had a claim against Krupps in respect of contracts under which £20,000 was due. They could not at present serve Krupps with a writ, so they asked the Court to protect them for the present by appointing a receiver of certain shares valued at £200,000 which Krupps had in an English company, so that these assets might be protected until plaintiffs could proceed with the action. Krupps might transfer the shares to, say, an American steel company, and security in this country would be gone. He submitted that on grounds of public policy British creditors of an alien enemy should be protected, and the Court ought to take possession of these assets for the benefit of creditors His Lordship said he must refuse the application, because he could find no authority for making such an order. He would, however, give leave to appeal.

British Branches of Foreign Businesses.

An interesting decision was given in the Court of Appeal, last month, when counsel appealed from a decision, on an *ex parte* application, made to Mr. Justice Scrutton, in Chambers, in the matter of Maxwell *v.* Grunhat, trading as the Hoffmann Construction Company, engineers, Finsbury Pavement House, E.C. It was explained that Grunhat, an Austrian subject, had left the country, but before the war he gave Maxwell a full power of attorney. Counsel asked for a declaration that, as the trustee, Maxwell should carry on the business, and that, under his power of attorney, he was entitled to collect money and give receipts for money due; counsel also asked that Maxwell should be appointed receiver. Lord Justice Buckley refused the application on the ground that it would, in certain events, be to the advantage of an alien enemy. A court is to be specially constituted to deal with such matters.

Brassworkers and Compensation.

A compensation case of some interest has been decided in the Wolverhampton County Court, where a bobbing worker claimed compensation for five weeks at the rate of 17s. per week from Messrs. Enoch Tonks & Sons, lock manufacturers of Temple Bar, Willenhall.

For the plaintiff it was stated that he contracted brass poisoning on July 13, and had since been incapacitated. The first week respondents paid him 17s., which was really compensation. Respondents contended that it was not, and when they found that brass poisoning was not a scheduled disease they discontinued the payment. Seeing that plaintiff contracted the poisoning whilst at his employment, and was incapacitated as a result, he had a just claim for compensation.

Defending counsel submitted that plaintiff had no claim within the meaning of the Act.

His Honour remarked that if the workman cut his knee and the brass dust got into the wound and caused incapacitation, he would hold that as being an accident arising out of his employment. There could, however, be only one conclusion at which he could arrive on the evidence—that the application should be dismissed with costs.

Personal.

Mr. Joseph Hill, of the St. George's Engineering Works, Woods Lane, Derby, has accepted the mayoralty of Derby for the ensuing year.

The late Mr. G. B. Pearce, of The Beeches, Hayle, Cornwall, managing director of William Harvey & Company, Limited, Bootle, left £43,396.

Mr. W. H. Ellis, a director of Davy, Bros., Ltd., and John Brown and Company, Limited, has been installed as the new Master Cutler of Sheffield.

The value of the personal estate of the late Mr. D. Campbell, managing director of Jones & Campbell, Limited, ironfounders, of Larbert, is £10,284.

The Marquess of Graham has been elected president of the Junior Institution of Engineers for the year 1914-15, in succession to Sir Boverton Redwood, Bart.

The late Mr. Andrew Paisley, engineer, of Eddleston, Overtoun-drive, Rutherglen, Glasgow, left personal estate in the United Kingdom valued at £14,132.

The gross value of the estate of the late Mr. G. B. Bayliss, J.P., chairman and joint managing director of the King's Norton Metal Company, Limited, is £51,845.

The late Mr. M. W. Johnson, of Locke, Lancaster, and W. W. and R. Johnson & Sons, Limited, lead smelters, of Millwall and Limehouse, left estate of the value of £65,316.

The late Mr. D. W. Abernethy, of the firm of Messrs. James Abernethy and Company, Ferryhill Foundry, Aberdeen, left personal estate in the United Kingdom valued at £26,210.

The gross value of the estate of the late Mr. T. R. Parkes, malleable ironfounder, etc., of Haywood, Halesowen, near Birmingham, is £47,085, including net personalty of £30,163.

Mr. J. G. Harrison and Mr. E. Purdy have been admitted into partnership by Messrs. Bushell, Nicol and Company, consulting engineers, etc., of 21, Collingwood Street, Newcastle-on-Tyne.

The late Mr. W. Barraclough, a director of Wm Barraclough, Limited, ironfounders, etc., of Stanningley, Leeds, left estate of the gross value of £12,683, of which £7,713 is net personalty.

The late Mr. T. F. Shillington, a director of Musgrave & Company, Limited, St. Ann's Ironworks, and Cromac Foundry, Belfast, left personal estate in the United Kingdom valued at £8,083.

Mr. E. H. Gary, chairman of the United States Steel Corporation, is reported to have resigned the position he holds on the boards of companies which are not connected with the Corporation.

Mr. A. Cook, late of P. & W. MacLellan, Limited, Glasgow, and Sir William Arrol & Company, Limited, has been appointed salesman in London for the Lanarkshire Steel Company, Limited, Motherwell.

Mr. W. S. MacLellan, one of the directors of P. and W. MacLellan, Limited, Clutha Iron Works, Glasgow, has been the recipient of a presentation from the officials and men, on the occasion of his marriage.

Mr. M. M. Henderson, son of the late Mr. John Henderson, for many years manager of the Bothwell Works, has been appointed chief mechanical engineer to the railways of the Commonwealth of Australia.

Mr. R. M. Glover, of the firm of Bessler, Waechter & Company, Limited, iron, tinplate and metal merchants, has been elected a director of the Newcastle Exchange, in succession to the late Mr. T. Bell.

Major F. Kayser, brother of Mr. C. W. Kayser, managing director of Messrs. Kayser, Ellison & Company, Carlisle Works, Sheffield, has been promoted Lieutenant-Colonel of the 23rd Battalion London Regiment.

The employés and staff of Gillespies, Limited, Empire Stove and Iron Works, Bonnybridge, have presented Mr. W. J. S. Gillespie, a member of the firm, with a token of their esteem and regard on the occasion of his marriage.

Mr. J. Hammersley has been appointed Manchester resident engineer for Messrs. Home-Morton, Ker & Gibson, consulting engineers, of Norwich Union Chambers, Congreve Street, Birmingham, and 153, St. Vincent Street, Glasgow.

King Gustavus V. of Sweden has conferred the honour of Knight Commander of the second class of the Order of Vasa upon Mr. Tord Magnusson, chief director of the Sandviken Ironworks, and Mr. Erik Frisell, chief director of the Grängesberg Iron Ore Company.

Mr. G. S. Clover and Mr. M. Clover have been elected directors of Clover, Clayton & Company, Limited, shipbuilders, engineers, and boilermakers, of Birkenhead and Liverpool. Both gentlemen have been closely associated with the business for many years.

Sir Thomas Wrightson, Bart., has been presented with a gold loving cup in appreciation of his fifty years' work in connection with the Teesdale Iron Works. The presentation was made at the offices of the firm at Thornaby, in the presence of a large company of directors and officials.

Mr. Robert Shaw, chief estimating engineer to Bruce Peebles & Company, Limited, Edinburgh, has joined the Engineer Units of the Royal Naval Division for active service abroad, and as he will in all probability be away for some little time, Mr. William Oliver has been appointed to temporarily fill Mr. Shaw's position with the firm.

Deaths.

Mr. William R. Lindsay, M.I.Mech.E., died at Dundee, on September 24, aged 65 years.

Mr. J Attwood, anvil and vice manufacturer, of the New Works, Hayes, Stourbridge, died recently at the age of 66 years.

Mr. G. M. Lane, a well-known Anglo-American financier, and one of the directors of the United States Steel Corporation, died at Boston, U.S.A., on October 3.

The death is reported of Mr. J. Blomfield, of St. Botolph's, Colchester, who was associated with the Britannia Engineering Company (1910), Limited, of the Britannia Works, Colchester. He was 79 years of age.

The death took place on October 19 of Mr. John Hair, at his residence, 5, The Promenade, Vickerstown, Barrow-in-Furness. Mr. Hair was 59 years of age, and was one of the managers on the engineering side of the business of Vickers, Limited, Barrow.

Mr. G. F. Loudon, a principal in the engineering firm of Messrs. Loudon Brothers, Johnstone, died on October 4, at his residence in Monkton, Ayrshire. The deceased, who was a native of Kilmarnock, was well known in Glasgow business circles. He was a Justice of the Peace for Ayrshire, and a member of the County Council.

The death has taken place at his residence, St. Helen's Road, Swansea, at the age of 83 years, of Mr. Edward Roberts, J.P. A native of Gwaunysgor, Flint, the deceased gentleman went to South Wales in his early days, and became a prominent official of the old Ystalyfera Iron Company. Subsequently he started business on his own account as a metal broker, and after an active career, retired some years ago.

The death is reported at the advanced age of 69 years of Mr. J. G. H. Bedford, who was well-known in the iron and steel industries. Mr. Bedford, who was born in 1845, was a member of the firm of John Bedford & Sons, Limited, steel manufacturers, Lion Works, Sheffield, and was one of the three original managing directors of that company. Although he retired from active participation in the business of the firm about ten years ago, he remained a director up to the time of his death.

The death has occurred of Mr. T. Blackadder, engineer, of Falkirk. The deceased gentlemen, who was born at Goshen, Stenhousemuir, was the son of Mr. Thomas Blackadder, of the Carron Iron Works, and adopted engineering as his profession. Upwards of sixty years ago Mr. Blackadder, along with his brothers, founded the firm of Blackadder Brothers, which he carried on with marked success till his retirement from business about ten years ago. He was in his seventy-seventh year.

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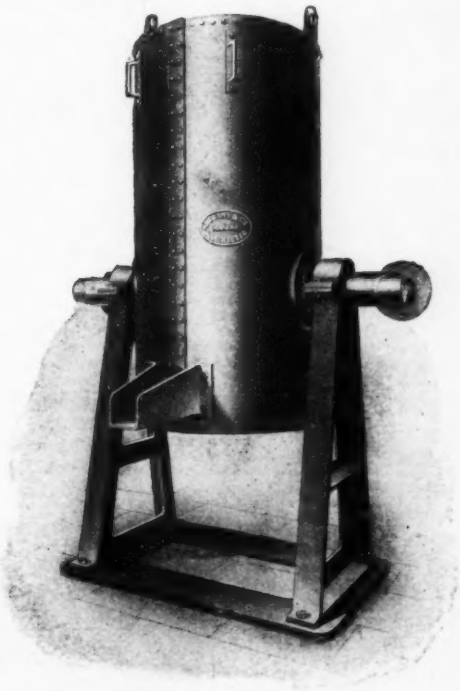


James Evans & Co.,
Britannia Works,
Blackfriars,
MANCHESTER.

Telegrams: "LADLES, MANCHESTER,"
Telephone: 2297 CENTRAL, MANCHESTER.

New Companies.

Metals (Birmingham), Limited.—Capital £3,000 in £1 shares.

Anglo-Spanish Metal Company, Limited.—Capital £50,000 in £1 shares (10,000 preference).

Le Duc, Limited.—Capital £250 in £1 shares, to carry on the business of iron founders, etc.

A. E. Harpham, Limited.—Capital £500 in £1 shares, to carry on the business of ironfounders, etc.

Hall, Streeter & Company, Limited.—Capital £100 in £1 shares, to carry on the business of ironfounders, etc.

Thomas Windibank & Company, Limited.—Capital £1,000 in £1 shares, to carry on the business of electrical engineers.

S. D. Murray & Company, Limited.—Capital £2,500, to take over the existing business of engineers and ironmasters.

New Lithoid (Limited) Covering Metal Process.—Capital £14,000 in £1 shares. King Edward Square, Sutton Coldfield, Warwick.

Western Foundries, Limited.—Capital £1,500 in £1 shares (500 preference). Registered office: Bridge Works, The Green, Southall, Middlesex.

Premier Cooler and Engineering Company, Limited.—Capital £8,000 in £1 shares. Registered office: Broadway Court, Westminster, London, S.W.

Stanley M. Travers, Limited.—Capital £1,250 in 1,000 preference shares of £1 each, and 5,000 ordinary shares of 1s., to carry on the business of engineers.

North British Electric Welding (Eastern), Limited.—Capital £4,000 in £1 shares. The first directors are J. Inglis, D. Small, H. M. M'Neal, E. A. Qualk, and L. S. Taylor.

A. Spafford & Company, Limited.—Capital £30,000 in £1 shares, to carry on the business of steel manufacturers. Registered office: Imperial Works, Brown Street, Sheffield.

Custodis, Limited.—Capital £6,000 in £1 shares (3,000 A and 3,000 B), to carry on the business of chimney constructors, etc. Registered office: 119, Victoria Street, Westminster, London, S.W.

Samuel Pinkney & Company, Limited.—Capital £4 000 in £1 shares, to acquire the business of iron and steel merchants, formerly carried on by R. Farrow and S. Pinkney, as Samuel Pinkney & Company, at William Street, Sunderland.

W. R. Pilkington & Sons, Limited.—Capital £1,000 in £10 shares, to carry on the business of engineers, iron and steel, brass and bronze founders, etc. The sole director is W. R. Pilkington, Bamber Bridge, near Preston. Registered office: 24, Gloverscourt, Preston, Lancs.

S. Santler & Company, Limited.—Capital £8,000 in £1 shares, to take over the business carried on at Malvern Link, Worcestershire, as C. Santler & Company, and to carry on the business of mechanical engineers, etc. The first directors are W. H. Lawton, P. R. Farrant, T. C Santler, and W. R. Santler.

Rankin & Blackmore, Limited.—Capital £85,000 in £1 shares (50,000 preference), to take over the business of Rankin & Blackmore, Eagle Foundry, Greenock. The first directors are J. F. Rankin, M. Rankin, A. McLeod, and H. Ferrier. Registered office: Eagle Foundry, 28, Baker Street, Greenock.

Miraculo Carburettor Jet, Limited.—Capital £1,000 in £1 shares, to carry on the business of wholesale and retail dealers in engineering requisites, etc. The first directors are A. G. France (managing director), E. J. Webb (chairman), and J. H. Van Meurs (secretary). Registered office: 37, St. Mary Axe, London, E.C.

M. & W. Grazebrook, Limited.—Capital £50,000 in £1 shares (20,000 6½ per cent. cumulative preference), to take over the business of ironmasters, etc., carried on at Netherton Ironworks, Dudley, by F. & O. P. Grazebrook, as M. & W. Grazebrook. The first directors are F. Grazebrook, O. F. Grazebrook, and E. Cookson.

Charles Purden, Limited.—Capital of £10,000 in £1 shares, to take over the business of a manufacturer of and dealer in machine tools, mill gearing, safes, engineers' requisites and appliances, and general machinery and plant, carried on by C. Purden, at Lancaster Street, and Lench Street, Birmingham. Registered office: City Machinery Stores, 48, Lancaster Street, Birmingham.

National Relief Fund.

The total of the National Relief Fund now amounts to £3,446,000. The following is our third list of subscriptions from the iron, steel, engineering and allied industries:—

£1,000.—A. & J. Inglis, Limited.

£500 each.—Port Talbot Steel Company, Limited; Benjamin Talbot; Iron Trades Employers' Insurance Association, Limited.

£300.—The Boilermakers' and Iron and Steel Shipbuilders' Society.

£262 10s.—Electric Construction Company, Limited.

£250 each.—Fleming & Ferguson, Limited; Hill & Smith, Limited; Cookson & Company, Limited; W. Gilbertson & Company, Limited; North-Eastern Marine Engineering Company, Limited.

£210.—Cape Copper Company, Limited.

£150.—Reid Brothers (Glasgow), Limited.

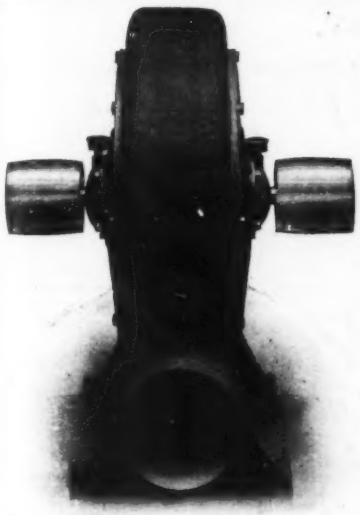
£105.—Aneurin Williams; Harfield & Company.

£100 each.—Sunderland Shipbuilding Company, Limited; Bull's Metal and Melloid Company, Limited; Samuel Tyzack & Company, Limited.

£50.—T. S. Forster & Sons, Limited; Harts Hill Iron Company, Limited; Davy Brothers, Limited.

£25 each.—Crane Foundry Company, Limited; G. M. Palmer; B. M. Renton; Peter Haggie & Company, Limited; N. Hingley & Sons, Limited.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.
J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."



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CUPOLA FANS.

Made in eight sizes from 10-in. to 35-in. diameter, and suitable for melting ½ to 20 tons per hour at pressures from 12—30 inches Watergauge.

Cast Iron Casings and Ball Bearings.

Double Inlet. All Types of Discharge.

Write for Bulletin No. 2028F.

DAVIDSON & CO., LIMITED,

Sirocco Engineering Works,

BELFAST.

ELDERS FOUNDRY COKE

AS SUPPLIED TO THE BRITISH ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using you Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Collieries, Ltd., Cardiff.

Telegraph : ELDER, CARDIFF. Telephone : 4640 and 4641.

MONTHLY PRICE LIST.

The undermentioned prices, unless otherwise specified, are those obtaining on the first day of the current month.

Pig-Iron.

Cleveland.

	s.	d.
Cleveland No. 1	51	9
,, No. 3	49	6
,, No. 4 foundry	49	0
,, No. 4 forge	48	6
,, Mottled	48	3
,, White	48	3
East Coast hematite, mixed Nos.	62	6
Cleveland warrants	49	3

Above prices are for early f.o.b. deliveries, and as regards Cleveland iron are for G.M.B. brands. The warrant quotations are the sellers cash prices.

Scotland.

	s.	d.
Standard Foundry (Glasgow Market settlement price)	48	9
Warrants, ditto	55	1½

Makers' prices:—	s.	d.		s.	d.
Gartsherrie No. 1	68	6	No. 3	63	6
Coltness No. 1	68	6	No 3	68	6
Summerlee No. 1	69	0	No. 3	64	0
Langloan No. 1	69	0	No. 3	64	0
Calder No. 1	69	0	No. 3	64	0
Clyde No. 1	69	0	No. 3	64	0
Carnbroe No. 1	67	6	No. 3	63	6
Monkland No. 1	64	0	No. 3	63	0
Shotts No. 1	70	6	No. 3	65	6

(All deliverable alongside Glasgow.)

Glengarnock	No. 1	70	0	No. 3	65	0
Eglinton	No. 1	62	6	No. 3	61	6

(All deliverable alongside Ardrossan.)

Dalmellington	No. 1	65	6	No. 3	63	6

(Deliverable alongside Ayr.)

Carron	No. 1	69	0	No. 3	64	0

(F.a.s. Grangemouth.)

Lancashire.

	s.	d.	s.	d.
Lancashire No. 3 foundry f.o.t.	—		—	
Lincolnshire No. 3 foundry	—		59	0
Derbyshire No. 3 foundry	—		59	0
Staffordshire No. 3 foundry	—		60	0
Cleveland No. 3 foundry	—		60	0

(All delivered equal Manchester.)

Scotch No. 3	Gartsherrie	—	68	0
	Glengarnock	—	66	0
	Eglinton	—	65	0
	Summerlee	—	66	0

(Delivered Manchester Docks.)

North-West of England.

	s.	d.	s.	d.
Bessemer mixed numbers net f.o.b.	71	0	72	0
Hematite warrant net cash	—		66	0
Lorn cold-blast charcoal iron	180	0	130	0

The Midlands.

		s.	d.	s.	d.
Staffs.	Common forge	55	0	56	0
	Part Mine forge	58	0	59	0
	Best All Mine	—		82	6
	Cold Blast	—		130	0

Strong forge, about 1s. less than grey forge; Mottled and White, about 2s. less than forge; Foundry No. 3, 3s. to 5s. above forge; No. 1 and No. 2, from 1s. 6d. to 2s. above No. 3; No. 1, about 2s. above No. 2.

Northampton foundry	—	—
North Staffs. foundry	—	—
Derby foundry	—	—
Nottinghamshire foundry	—	—
Leicestershire foundry	—	62 0
Shropshire Cold-Blast	—	—

(Delivered South Staffordshire Works, net cash monthly.)

Lincolnshire.

	s.	d.	s.	d.
Forge	—		—	
Grey forge	—		—	
Basic	—		—	
No. 3 foundry	—		56	0
No. 4 foundry	—		—	

F.o.t. Makers' works.

South Wales.

	s.	d.	s.	d.
Welsh Hematite	71	0	72	0

Ferro-Alloys.

Net, Delivered Sheffield Steel works.

	£	s.	d.	£	s.	d.
Ferro-chrome: 4/6% carbon, Basis 60%, scale 10s. per unit, Per ton	26	0	0			
Ferro-chrome: 6/8% carbon, Basis 60%, scale 10s. per unit, Per ton	24	0	0			
Ferro-chrome: 8/10% carbon, Basis 60%, scale 8s. 6d. per unit, Per ton	22	15	0			
Ferro-chrome: Specially refined, guaranteed maximum 2% carbon, broken to small pieces for use in best quality crucible steels, Basis 60%, scale 22s. per unit, Per ton	54	15	0			
Ferro-vanadium: 33/40% Va., per lb. of Va. contained in the alloy	0	10	0			
Ferro-silicon: 45/50%. Basis 50%, 5s. scale per unit Per ton	15	0	0			
Ferro-titanium: 15/18%, per pound, flat	0	0	6½			
Ferro-molybdenum: 70/80% Mo. per pound of Mo. contained	0	18	0			
Ferro-phosphorus: 20/25%. Per ton	0	14	0			
*Ferro-manganese 80% export	10	5	0	10	10	0
,,	—					

* F.o.b. Liverpool.

Iron Castings.

Cleveland.

	£	s.	d.	£	s.	d.
Columns (plain)	7	7	6	to 7	12	6
Pipes, 1½ to 2½ in.	6	7	6	6	12	6
,, 3 to 4 in.	5	17	6	6	0	0
,, 5 to 8 in.	5	12	6	5	15	0
,, 10 to 16 in.	5	15	0	—		
,, 18 to 24 in.	5	15	0	—		
Chairs	4	5	0	4	6	0
Floor plates (open sand)	3	10	0	3	12	6

(At works.)

Non-Ferrous Metals.

Copper.

	£	s.	d.
Standard, Cash	—		
Three months	—		
Electrolytic	52 15 0	53	0 0
Tough	—	53	10 0
Best selected	54 10 0	55	0 0

Tin.

	£	s.	d.
Standard, Cash	—		
,, Three months	—		
English Ingots	132 10 0	133	0 0
Bars	133 10 0	134	0 0
Refined	—		

Spelter.

	£	s.	d.
Silesian	24	10	0
Specials	—		
Hard	20	10	0
British	25 10 0	26	10 0

Lead.

	£	s.	d.
Soft foreign	17	15	0
English	18 5 0	18	10 0

Antimony.

	£	s.	d.
Regulus	—	55	10 0

Aluminium.

	£	s.	d.
Virgin Metal, 98/99% per ton		86	0 0

*Chromium (Metallic).

	£	s.	d.
98/99% purity per lb.	—		

*Nickel.

	£	s.	d.
In cubes, 98/99% purity Per ton		197	10 0

*Tungsten Metal Powder.

	£	s.	d.	£	s.	d.
96/98% purity per lb.	0	5	0	0	5	3

*Molybdenum Metal.

	£	s.	d.
96/98% purity per lb.	—		

*Cobalt Metal.

	£	s.	d.	£	s.	d.
97% purity per lb.	0	6	9	0	8	0

Quicksilver.

	£	s.	d.	£	s.	d.
75 lb. bottle	10	0	0	10	10	0

* Net, Delivered Sheffield Works.

Scrap Iron and Steel.

Cleveland.

	s.	d.		s.	d.
Steel scrap, heavy melting	49	0	to	51	0
Iron scrap cast (cupola metal)	52	6		55	6

London (f.o.b.).

	s.	d.
Heavy steel	47	6
Light ,,	32	6
Heavy cast	49	0

Non-Ferrous Scrap.

London merchants quote, delivery free, and subject to market fluctuations:—

	J. B. Garnham and Sons. £	s.	d.	A. Joseph. £	s.	d.
Brass	36	15	0	37	10	0
Clean copper	47	0	0	47	0	0
Braziery copper	42	0	0	41	0	0
Old lead	15	10	0	15	15	0
Tea lead	—			14	5	0
Old zinc	16	0	0	17	10	0
Hollow pewter	80	0	0	90	0	0
Black pewter (shaped)	50	0	0	56	0	0
Gun metal	47	0	0	48	0	0
Aluminium (cuttings)	—			62	0	0

Stocks.

Pig-Iron in Public Store.

	Oct. 29. Tons.	Inc. + or Dec. — since Oct. 30. 1913. Tons.
Connal's at Glasgow Scotch	1,000	No change.
Ditto other makes	—	— 20
Connal's at Middlesbrough	106,774	— 55,129
Connal's at Middlesbrough, hematite	—	No change.
West Coast hematite	3,041	— 8,984

Metals.

Copper, Europe and afloat	36,566	+ 10,739
Tin, London, Holland, U.S.A. and afloat	13,128	+ 79

Coke.

Middlesbrough.

	s.	d.		s.	d.
Gas Coke	12	0		12	3
Foundry Coke	18	6	to	19	0
Furnace coke	—			17	6

Newcastle-on-Tyne.

	F.o.b s.	d.	Dunston. s.	d.
FOUNDRY COKE—				
Original Garesfield			20	6
Mickley			19	6
Stella Garesfield			20	6
Priestman's Garesfield			20	6
Consett Garesfield			20	6
Newcastle gas coke			12	3

Cardiff.

	s.	d.		s.	d.
Special foundry coke	27	0	to	30	0
Foundry coke	20	0	to	24	0
Furnace coke	17	0	to	19	0

Leeds.

	s.	d.		s.	d.
Furnace coke (washed)	10	6	to	11	0

Birmingham.

Foundry coke	—				
Furnace ,,	15	0	to	17	0
Gas ,,	—				

Glasgow.

Foundry coke	—			26	0
Furnace ,,	—			20	0
Gas ,,	—			8	6

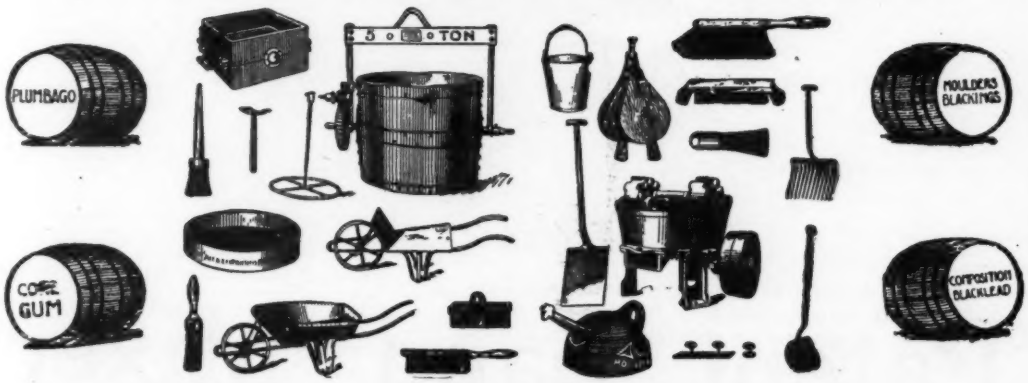
London.

Foundry coke	25	0	to	30	0
Gas coke (Beckton), into barge	—			11	9
,, into wagon at Works	—			12	9
Gas coke, Provincial (London sidings)	14	6	to	14	9

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.



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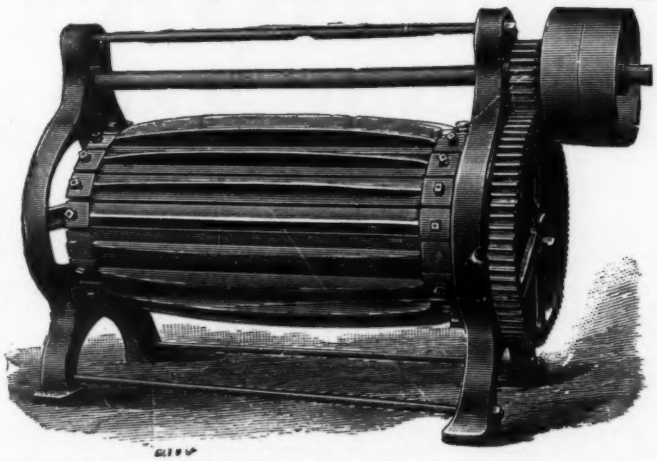
COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Improved Foundry Rattler or Fettling Drum.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

Patent Sand Mixer

Uses up more old sand than has hitherto been considered possible.

Our Patent Sand Mixer has the following desirable advantages.

The sand is thoroughly aerated, rendered light and loose in texture and of even temper.

Previous milling of the sand is unnecessary.

Seven hundredweights of sand dealt with per minute.

All bearings are ball bearings.

All gears are casehardened steel.

All gears and bearings run in an oil-bath rendering them practically everlasting.

Cages easily examined and cleaned.

Cages do not clog as there are no curved passages.

Machines can be seen in operation in our foundries, Edgwick, Coventry.

ALFRED HERBERT, Limited,

Coventry.

SITUATIONS VACANT AND WANTED.

BRASS FOUNDRY FOREMAN wants position; 31 years' experience, 14 in U.S.A. Knows Business from A to Z. All up to-date methods on all kinds of metals. —Address Box 540, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

FOUNDRY FOREMAN, age 35, desires change. Expert metal mixer, tensile tests, 11 tons. Ratio coke to iron, 1 to 10. Abstainer, up-to date, disciplinarian. —Box 536, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

MOULDER (38), home from abroad. Abstainer, non-society, reliable. Good at all moulds, mix all metals. Good technically. Best testimonials. Mine or Furnace work preferred. Would take charge small shop.—Address Box 545, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

FOR SALE AND WANTED.

HALL'S INVINCIBLE SAND MIXERS are now successfully in use for preparing NEW SANDS and UTILIZING OLD SANDS in some of the LARGEST FOUNDRIES.—Write for information and prices to C. E. V. HALL, Paradise Chambers, Sheffield.

TO BRASS FOUNDERS AND OTHERS.—For SALE, almost new HAND MOULDING MACHINE, SAND MILL, ROTARY SIEVE, First Class GAS ENGINE, LATHES, and other Machines.—Apply Box 490, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

MORTAR MILLS.—For SALE, 6 ft. 6 in. dia. and 7 ft. 6 in. dia., under-driven, false bottoms.—Apply JOHN VARLEY & CO., LTD., St. Helens, Lancs.

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FOR SALE.—60 Pairs of MACHINE MOULDING BOXES, 17 in. by 11 in. by 4 in. deep. What offers.—L.D.T., 82, York Road, King's Cross, London, N.

FOR SALE.—STEEL FOUNDRY LADLES, with Worm Gearing, in first-class condition.

1 15 Tons capacity, 5 ft. dia. by 5 ft. deep.
1 7 ,, ,, 4 ft. ,, by 4 ft. ,,
1 5 ,, ,, 3 ft. 5 in. ,, by 3 ft. 3 in. ,,

THOS. W. WARD, LTD., Silvertown, E.

CORE GUM. ROSIN. CORE GUM. ROSIN.

IT will Pay you to write me for Samples and Prices. EDGAR KENYON, Direct Importer.

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SPECIAL PIG IRON

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ASK FOR OUR SUGGESTIONS FOR ECONOMICAL IRON MIXTURES.

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Stamped Brass Letters.

All kinds of Letters for Pattern-making and Foundries supplied from stock at very advantageous prices.

Solid (cast) Brass Letters

Walco, Ltd.,

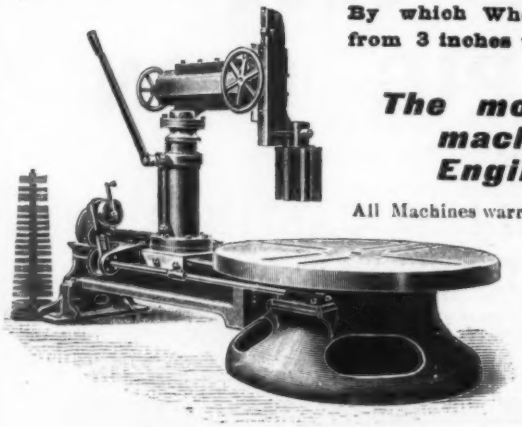
66-68, Slaney Street,

Birmingham.

38¼"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
36"
32½"

Can also be made in Aluminium.

WHITTAKER'S IMPROVED MOULDING MACHINE



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The most complete and efficient machine hitherto introduced to Engineers.

All Machines warranted to Mould with the greatest accuracy and precision.

GEARING WHEELS

Spur or Bevel, Straight Teeth and Double Helical Teeth Supplied to Consumers.

ROPE & BELT PULLEYS.

WM. WHITTAKER & SONS, LTD.,

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	Alldays & Onions, Ltd.	Birmingham	Alldays, Birmingham	28 Victoria
737	Anglo-Mexican Petroleum Products Co., Ltd.	Finsbury Court, Finsbury Pavement, E.C.	Mexproduct, Ave., London	City 2704
C. iii.	Braby, F. & Co., Ltd.	Petershill Road, Glasgow	Braby, Glasgow	—
736	Bradley, T. & I., & Sons, Ltd.	Darlaston	Bradley, Darlaston	—
780	Bridge, D. & Co., Ltd.	Castleton, Manchester	Coupling, Castleton, Manchester	25 Rochdale
737	Britannia Foundry Co.	Coventry	Stoves, Coventry	251
729	British Aluminium Co., Ltd.	109, Queen Victoria Street, E.C.	Cryolite, London	4315 London Wall
737	British Binderit Co., Ltd.	317, High Holborn, London, W.C.	Bindercomp, Holborn, London	950 Holborn
C. iv.	Buckley & Taylor, Ltd.	Castle Iron Works, Oldham	Engines, Oldham	Oldham No 8
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728	Cumming, William, & Co., Ltd.	Maryhill, Glasgow	Prudence, Glasgow	P. O. M. 25
775	Davidson & Co., Ltd.	Belfast	Sirocco, Belfast	4341 Belfast
727	Davies, T., & Son	West Gorton, Manchester	Tuyere, Manchester	70 Openshaw
777	Durrans, Jas., & Sons.	Penistone, nr. Sheffield	Durrans, Penistone	—
C. ii.	Dyson, J. & J.	Sheffield	Dyson's, Stannington	702 Sheffield
775	Elders' Collieries, Ltd.	Cardiff	Elder, Maesteg	10
738 & 773	Evans J., & Co.	Manchester	Ladles, Manchester	2297
		40, Chapel Street, Liverpool	Persistent, Liverpool	1134 Central (3 lines)
C. ii.	Everitt & Co.			—
779	Frodair Iron & Steel Co. Ltd.	5, Fenchurch Street, E.C.	Frodair, London	59 Shipley
C. ii.	Fyfe, J. R. & Co.	Shipley, Yorks	Brick, Shipley	
	Glasgow Patent Moulders Blacking Co.	26, Fleming St., Port Dundas, Glasgow	Moulders, Glasgow	—
726	Goldendale Iron Co., Ltd.	Tunstall, Stoke-on-Trent	Goldendale, Tunstall, Staffs	—
728	Gray, Thomas, E., & Co.	71, Lincoln's Inn Fields, Kingsway, London, W.C.	Papplewick, London	1193 City
C. ii.	Hall John & Co. (Stourbridge), Ltd.	Fire Clay Works, Stourbridge	Hall, Stourbridge	55 Stourbridge
778	Herbert, Alfred, Ltd.	Coventry	Lathe, Coventry	Coventry 860
728	Hislop, R. & G.	Paisley	Gas, Paisley	331 Paisley
731	Keith, James & Blackman, Co., Ltd.	27, Farringdon Avenue, London	James Keith, London	6194 H'lb'rn(4lines
731	King Bros. (Stourbridge), Ltd.	Stourbridge	King Bros., Stourbridge	—
	London Emery Works Co., Ltd.	Park, Tottenham	Naxium, London	99 Tottenham
774	Lowood, J. Grayson, & Co., Ltd.	Deepcar, nr. Sheffield	Lowood, nr. Sheffield	18 Stocksbridge
	Marshall, H. P., & Co.	Leeds	Specialty, Leeds	1909 Leeds
	Metalline Cement Co	112, Bath Street, Glasgow	Adhesive, Glasgow	201Y2 Douglas
	McLain's System	710, Goldsmith Bldg, Milwaukee, U.S.A.	—	—
780	McNeil, Chas.	Kinning Park, Glasgow	McNeil, Glasgow	X 155
734	Moorwood, F. C. & Co.	7, East Parade, Sheffield	Morod, Sheffield	4318
779	Naish & Croft	141, Whitehead Road, Aston Manor	—	—
731	Olsen, William	Cogan Street, Hull	Wm. Olsen, Hull	Nat. 1184
735	Phillips, Charles D.	Newport, Mon.	Machinery, Newport	—
C. iii.	Phillips, J. W. & C. J.	23, College Hill, E.C.	Colloquial, London	10112 Central
735	Pickles, James, Ltd.	Laurel St., Leeds Rd., Bradford	Pickles, Laisterdyke	3723 Bradford
730	Piftin, Ltd.	2, Fen Court, Fenchurch Street, E.C.	Russesco, London	11230 Central
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774	Sankey, Joseph & Sons, Ltd.	Hadley, Salop	Sankey, Hadley	—
	Silversteen, W., & Co.	147, Queen Victoria St. London, E.C.	Ottel.ws, London	8630 City
725	Standard Sand Co., Ltd.	Mansfield	Standard Sand Co., Mansfield	201 Mansfield
729	Stewart, D., & Co., Ltd.	London Road Iron Works, Glasgow	Stewart, Glasgow	71 P.O. Bridgton & 3243 Bridgton (N)
	Tilghman's Patent Sand Blast Co., Ltd.	Broadheath, nr. Manchester	Tilghmans, Altrincham	14
732	Thwaites Bros., Ltd.	Bradford	Thwaites, Bradford	3459&3460 Brd'd
736	Universal Machinery Corporation, Ltd.	326, Old Street, London, E.C.	Toolcraft, London	3762 London Wall
729	Walker, I. & I.	Rotherham	—	—
	Walco, Ltd.	53, Newton Street, Birmingham	Walco, Birmingham	Central 3305
780	Whittaker, W., & Sons, Ltd.	Oldham	Whittakers Engineers, Oldham	83
731	Wilkinson, Thos., & Co., Ltd.	Middlesbrough	Blacking, Middlesbro'	419
735	Williams, J. (Birmingham Sand), Ltd	Birmingham	—	—

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Mansfield, NOTTS.

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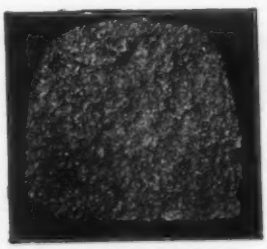
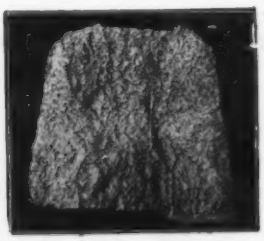
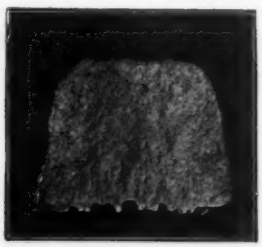

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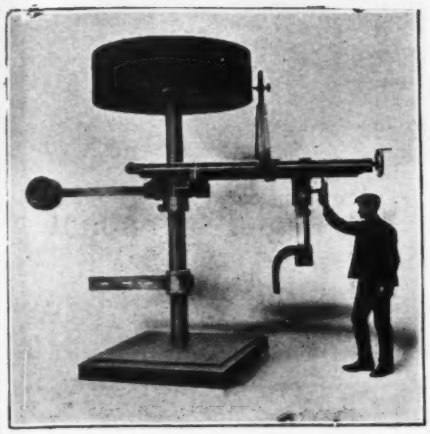

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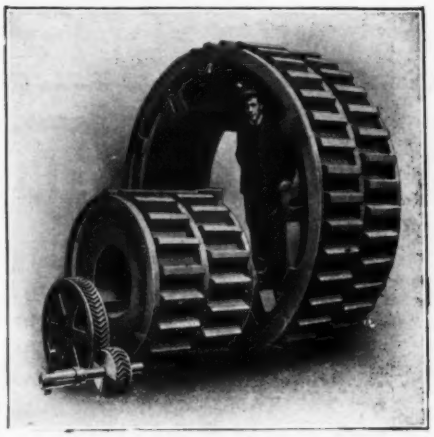

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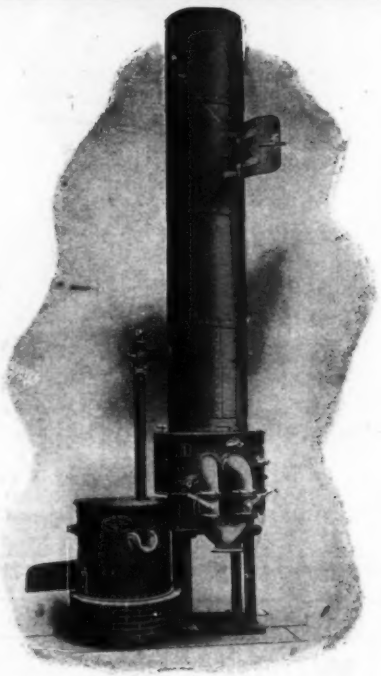

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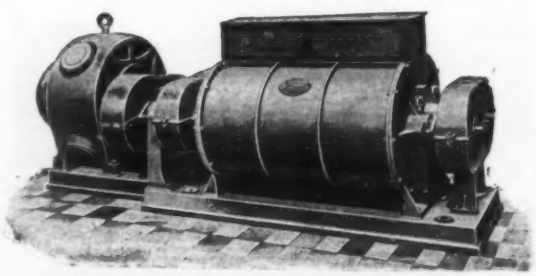

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FOUNDRITE is supplied in **LIQUID** form ready for use. Dilute with Water.

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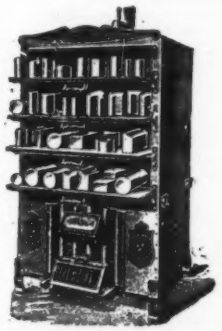

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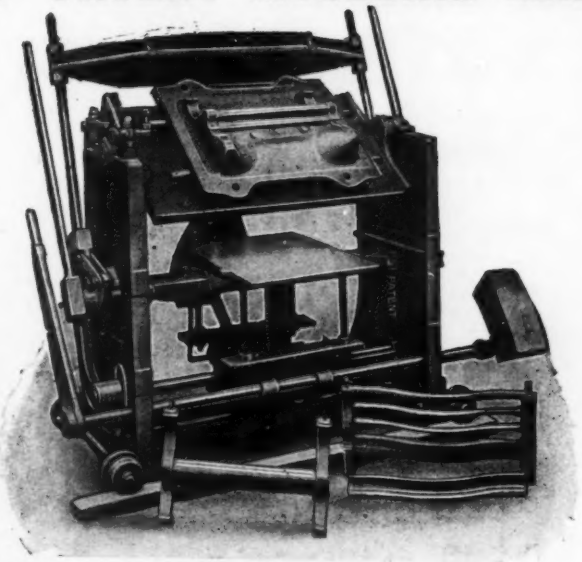

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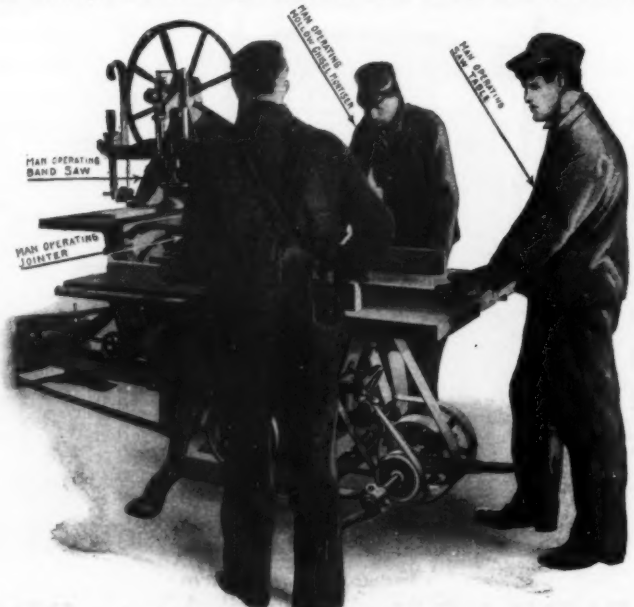

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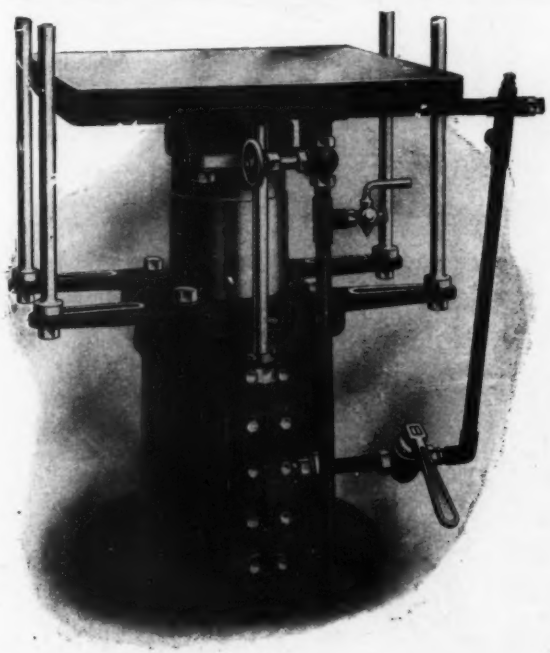

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